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Schedl (K. E.). **Erfahrungen und Beobachtungen anlässlich der Nonnengradation in der Steiermark in den Jahren 1946 bis 1948.** [Investigations and Observations in Connection with the Outbreak of the Nun Moth in Styria in the Years 1946–48.]—129 pp., 9 pls., 14 figs., 1 fldg. col. pl. in pocket, 34 refs. Klagenfurt, F. Kleinmayr, 1949. Price *S*.24.

An unusual outbreak of the nun moth [*Lymantria monacha*, L.] occurred on spruce in the Alpine valleys of Styria, Austria, in 1946–48 [*cf. R.A.E.*, A **36** 128]. An observation station was established at Wildalpen, and observations were made on the course of the outbreak, the bionomics of the moth and its natural enemies. An experiment on control by means of DDT sprays applied from an aeroplane was made in 1948. This book contains detailed accounts of the various phases of the work and of the results obtained, which are discussed with reference to previous knowledge and to the similar work in East Prussia [**35** 233–241].

The areas of forest in which all the spruce was killed increased from some 60 acres in six localities in the summer of 1946, when the outbreak was first detected, to 600 acres in 21 localities in 1947, and without the control campaign in 1948, it would doubtless have increased still further in that year. The cause of the outbreak was unknown, but spring temperatures in 1945–47 were above the average. It began in the interior of closed stands of spruce and spread also to mixed stands. All the areas affected were at altitudes between about 2,100 ft. and 3,300 ft. on the steep valley slopes, and the absence of infestation on the valley floors and at greater heights [*cf.* **36** 128–129] was striking. Mature trees died if 50 per cent. or more of their needles were destroyed in any one year, but they survived 30–50 per cent. loss except on exposed sites, and losses of 10–30 per cent. had no serious results. Other trees attacked were larch, which survived total defoliation in spring, producing new needles later in the summer, pine, which is uncommon in the area and of no importance, and fir [*Abies*], which is fairly common but appeared to be largely avoided. Isolated beeches and birches were infested in some places, but the damage was nowhere serious.

It was found in East Prussia that most of the eggs were laid on the lower part of the trunk [*cf.* **35** 236]. This was also the case in Styria in 1946, but in 1947, over half of them were found on the middle third. Egg mortality, as observed in the spring in defoliated areas, was 10·4–17·4 per cent., the chief factors involved being destruction by predators and the death of the fully developed embryos before hatching. The cause of the latter was not known, but was not polyhedral disease. Egg mortality decreased with altitude, being 32·7, 9·9 and 2 per cent. at 2,400, 2,625 and 2,950 ft., respectively, and the high mortality at the lowest level may explain the absence of infestation on the valley bottoms.

The eggs hatched between 16th April and 5th May in 1947, with a peak on 18th–20th April, and between 21st April and about 6th May in 1948. The first to hatch were mostly at the middle altitudes and the last at the highest points. The larvae ascended the trees after about five days and fed first on the lower part of the crown. The spruce buds were opening at this time, and it was observed that they did so the earliest at the middle altitudes. Observations on the tropisms of the larvae are recorded. Only 16 per cent. of over 2,000 mature larvae taken to the laboratory in 1947 pupated, and of the others, 54 per cent. were parasitised by the Tachinid, *Phorocera silvestris*, R.-D. (*Parasetigena segregata*, auct.) and 46 per cent. killed by disease or possibly mechanical injury. There was little evidence of polyhedral disease except in two localities [*cf.* **36** 129]. Pupation occurred in the laboratory between 19th June and 2nd July, and the pupal stage lasted 13–21 days for males and 12–26 days for females. Males pupated and emerged earlier than females.

Pupal mortality ranged from 50 to nearly 92 per cent. according to locality and was greatest in the centres of infested areas. Most of it was due to *P. silvestris*, which emerged from up to 89 per cent. of the pupae, followed by disease and lastly by other parasites. The latter comprised the Ichneumonids, *Ichneumon disparis*, Poda, *Theronia atalantae*, Poda, *Apechthis* (*Pimpla*) *capulifera*, Kriechb., *A. compunctor*, L. (*P. brassicariae*, Poda) and *P. turionellae*, L. (*examinator*, F.), *Sarcophaga schützei*, Kram., and *Monodontomerus interruptus*, Först. The Ichneumonids parasitised less than 3 per cent. of the pupae.

In the forest, the adults emerged from 1st to 10th July and were present until late August. The sex ratio was investigated separately for pupae and for adults on the lowest 10 ft. of the trunks. The percentage of females was 30–48 among pupae and only 8·5–35·1 among adults on trunks. The cause of the disparity between these two sets of figures was not known and was thought to lie in some peculiarity in adult habits in mountain regions, but if the proportion of females on trunks is not representative of the total population, Wellenstein's method of forecasting abundance [**35** 238] is not reliable.

A few observations were made on *Phorocera silvestris*, which was an important factor in controlling the outbreak. The adults emerged from 9th May to 12th June in 1948, and the percentage of males among hosts parasitised by it in 1947 ranged from 52·9 to 70, which was no doubt due to a preponderance of males among the moth larvae.

Surveys made to forecast moth abundance are described. Outbreaks of *L. monacha*, including the periods of preparation and collapse, usually last 4–7 years [*cf.* **35** 236], but the process is apparently much accelerated in Alpine regions, where sharply limited areas are involved. The period of preparation is brief, and the collapse usually occurs in the first year of mass feeding. The factors mainly responsible are parasitism by *P. silvestris*, which increases rapidly with its host, and the unfavourable effect of the abiotic environment on the young larvae.

The control work undertaken in 1948, which is described in detail, involved the application of 5 per cent. solutions of DDT to over 8,000 acres of forest from a Dakota aeroplane against the young larvae in late April. The results were excellent, the percentage mortality among larvae collected over the next ten days on cloths spread beneath the trees ranging from 89·6 for 0·342 lb. DDT per acre to 100 for 0·774 lb. per acre. Larvae continued to fall even after this period, and the few that survived were destroyed by natural enemies. Precautions against bark-beetles were taken in both 1947 and 1948, and no serious outbreaks occurred.

SCHEDL (K. E.). **Die Nonnengradation in Oesterreich.** [The Outbreak of the Nun Moth in Austria.]—*Öst. Forst- u. Holzw.* **3** Jän. Sondernum. pp. 1–6. Vienna, 1948. **Die Nonne.** [The Nun Moth.]—*Pflanzenarzt* **1** no. 10 pp. 1–3, 1 fig. Vienna, 1948. **Die Nonne in der Steiermark.** [The Nun Moth in Styria.]—*Öst. Vjschr. Forstw.* **90** pt. 2 pp. 65–81, 4 figs. Vienna, 1949. **Die Nonne. Leitfaden zur gegenwärtigen Gradation in Österreich.** [The Nun Moth. Guide to the present Outbreak in Austria.]—*Flugbl. Öst. Bundesminist. Land- u. Forstw.* no. 1, 31 pp., 8 figs., 9 refs. Vienna, 1948.

The first three of these papers refer to the outbreak of *Lymantria monacha*, L., on spruce in Styria in 1946–48 [see preceding abstract]. The situation up to the end of 1947 is described in the first, the second contains a short popular account of the bionomics of the moth, the course of the outbreak and its control, and the third comprises a rather more detailed account of the work done, with special attention to the control of the larvae in 1948 by sprays of DDT applied from an aeroplane. The fourth publication is a popular account of the bionomics of the moth and methods of forecasting its abundance, published to assist workers and others concerned in the outbreak.

SCHIMITSCHEK (E.). **Stand der Massenvermehrung und Bekämpfung des** *Ips typographus* **in Niederösterreich.** [The Outbreak of *I. typographus* in Lower Austria and its Control.]—*Öst. Forst- u. Holzw.* **3** Jän. Sondernum. pp. 7–15, 3 refs. Vienna, 1948.

The outbreak of *Ips typographus*, L., that occurred on spruce in Lower Austria in 1945–47 [*cf. R.A.E.*, A **38** 49, 144] was due to the presence of numerous trees damaged by war operations [*cf.* **38** 50] and the occurrence of unusually warm dry summers in those years, and it was favoured by the planting of spruce in unmixed stands in areas where that tree does not normally grow. The distribution of the infested areas and the amounts of timber damaged are discussed in some detail.

Owing to the warm weather in 1947, the young overwintered adults emerged from hibernation as early as the end of March or beginning of April in some places. They flew to trap logs or to healthy trees for maturation feeding, which was a result of development under crowded conditions and consequent undernourishment, and became sexually mature in late April or early May, according to altitude. Their progeny developed rapidly, owing to the warm weather, and there was a further emergence of adults in the second half of June and still another in August at the lower altitudes (below about 1,600 ft.) and in places exposed to the sun at higher ones. It was observed that the emergence of adults of each generation occurred in several sharply defined waves, corresponding to the occurrence of hot sultry days. Observations on the duration of the flight and developmental periods at places at various altitudes are recorded. Infested trees showed discoloured needles earlier than usual, probably as a result of the drought, and discoloration due to summer infestation, which is usually not perceptible before the end of the following winter, became noticeable from August onwards.

Very little control was afforded by natural enemies. Ichneumonid parasites of the genera *Coeloides*, *Rhopalicus* and *Rhoptrocerus* were identified but parasitised less than 0·1 per cent. of the population. The various ways in which sprays of calcium arsenate can be used on trap logs and felled trees to control the beetle are described, and the favourable results obtained with them in 1947 [*cf.* **38** 144] are discussed at some length.

KOEHLER (W.). *Troilus luridus* **F. (Hem.-Het.).** [*In Polish.*]—*Trav. Inst. polon. Rech. for.* (A) no. 51, 79 pp., 7 pls., 5 figs., 2 fldg. tables, 31 refs. Warsaw, 1948. (With a Summary in English.)

A detailed account is given of the bionomics of the predacious Pentatomid, *Troilus luridus*, F., as observed in 1936–38 in pine stands and mixed forests in central Poland and north-west of Gdynia and in the laboratory. Its distribution in Poland, where it is common, is outlined, all stages are described in detail, and a key to the five nymphal instars is given. There was one complete generation a year, the adults hibernating from mid-September, possibly in the forest litter. The earliest dates on which eggs, nymphs and young adults were observed in the forest were 19th May, 20th June and 23rd August. The eggs were laid in small batches, usually on pine needles, though a few were found on alder. Oviposition continued until mid-July and a female in the laboratory laid 96 eggs. In laboratory breeding experiments, the eggs hatched in 7–12 days and the nymphal stage lasted 28–39 days for males and 33–45 for females. The adults became mature 7–11 days after emergence. First-instar nymphs were gregarious and fed exclusively on the needles of conifers and the leaves of other trees and bushes. Those of later instars required the addition of animal food, and died in its absence, though a lack of vegetable diet did not hinder their development. They did not feed on the eggs of insects, but attacked various soft and hairless larvae, and sometimes pupae and adults. They accepted dead insects as readily as living ones, and also attacked weak or sickly individuals of their own species. The insects on which the bugs have been observed to feed are recorded in a table, with the stage attacked, the observer and the year. The hosts recorded by the author comprised larvae of *Panolis flammea*, Schiff., *Bupalus piniarius*, L., *Lymantria dispar*, L., and *Diprion* sp., and larvae and adults of *Agelastica alni*, L., in the field and larvae of *Dendrolimus pini*, L., *Syrphus* sp., and various Pentatomids in the laboratory.

The degree of control of forest pests exercised by *T. luridus* could not be accurately ascertained, but it was calculated that a single individual destroyed 122 insects in the course of its life in the laboratory ; it would probably destroy half that number in the field. In the forests, the bugs occurred almost exclusively in the crowns of the pines and were seldom found on the ground cover. They were more numerous in mixed forests than in pure stands of pine. Of the eggs collected in different localities in 1938, those taken in May and June were not parasitised, but 26–29 per cent. of those taken in July gave rise to *Microphanurus semistriatus*, Nees.

KARPIŃSKI (J. J.). **Kózki (Cerambycidae) puszczy Białowieskiej.** [The Longicorns of the Forest of Bialowies.]—*Trav. Inst. polon. Rech. for.* (A) no. 55, 33 pp. Warsaw, 1949. (With Summaries in Russian and French.)

A list is given of 89 species of Longicorns collected in the forest of Bialowies in 1929–39. Symbols show the trees attacked by 51 of them and indicate that 33 are injurious. Further lists of all the Longicorns known from Poland up to 1939, and of species that have erroneously been recorded there, are appended.

FRIEND (R. B.). **Connecticut State Entomologist, Forty-sixth Report, 1946.**—*Bull. Conn. agric. Exp. Sta.* no. 512, 114 pp., 12 figs., refs. New Haven, Conn., 1946.

R. B. Friend (pp. 7–16) discusses the prevalence of certain insect pests in Connecticut during the year ending 31st October 1946 and gives a short account of the work of the Department of Entomology in investigating and carrying out control measures against them. M. P. Zappe & L. A. DeVaux (pp. 17–19) summarise the results of the annual inspection of nurseries for pests and diseases ; of 326 inspected, 166 were free from any pests that required control measures. Pine leaf scale [*Phenacaspis pinifoliae*, Fitch] was present in only eight nurseries [*cf.* *R.A.E.*, A **37** 371] and Dutch elm disease [*Ceratostomella ulmi*] in five. The oyster-shell scale [*Lepidosaphes ulmi*, L.] was one of the commonest pests and was found on numerous food-plants, such as lilac, fruit stock, willow, poplar and ash. In a section dealing with the control of the gipsy moth [*Lymantria dispar*, L.], O. B. Cooke (pp. 25–29) reports that a survey of 63 towns in seven counties revealed the presence of 183 infested areas containing approximately 400,000 new egg-masses. Some of the infestations were of such size as to require control, and spray programmes were carried out in the spring and early summer. Two heavily infested areas were sprayed by aeroplane with DDT in oil at the rate of 1 lb. DDT per acre, and 59 others were sprayed with DDT or lead arsenate by ground equipment. A survey in the eastern and central sections of the State showed that although the area defoliated was somewhat larger in 1946 than in the previous year, there was no cause for alarm since it could be reduced by suitable control measures. A survey of the western part of the State did not indicate any serious spread of the moth into hitherto uninfested areas. Temperatures during the winter of 1945–46 were not low enough to affect the viability of the eggs seriously, and 81 per cent. of the eggs hatched in egg-masses collected from various parts of the State in spring. Hatching was first observed on 22nd April and was general between 2nd and 17th May. Pupae and adults were first observed on 24th June and 7th July, respectively, and the last male was seen on 2nd August.

J. C. Schread (pp. 46–48) reports that the adult population of the Japanese beetle [*Popillia japonica*, Newm.] in Connecticut was noticeably greater in 1946 than for several years, partly as a result of a comparatively wet summer in 1945 and a decidedly wet season in 1946, and gives details of infestation in different parts of the State. He further reports (pp. 49–50) that, owing to unfavourable weather, parasites of *P. japonica* were less numerous than usual in the spring of 1946. Adults of *Tiphia vernalis*, Mg., were found at only eight colonisation sites and never in sufficient numbers to permit collection for recolonisation, but *T. popilliavora*, Rohw., showed a marked tendency to increase in the Bridgeport area, where it had been very scarce for a number of years. Failure of this parasite to become numerous prior to 1946 is attributed largely to the cutting of the flower stalks of wild carrot when the flowers began to open, which deprived the adults of their only known source of food. *Centeter cinerea*, Aldr., which is a potentially important parasite of the adult beetles, was recovered from several colonisation sites in Hartford County, and both this species and *T. vernalis* were distributed in new areas. The milky disease [*Bacillus popilliae*] of the larvae continued to be very effective in plots in which it had been established 6–8 years before in three counties and showed an average incidence of 70 per cent. in June, when soil temperatures were favourable to it [*cf.* **37** 372]. Accumulated evidence shows that there has been a decided decline in the population of *P. japonica* for three years in Fairfield County, where the disease organism was broadcast in all but six towns in 1941 and 1942. A 10 per cent. DDT dust, applied at 250 lb. per acre on 20th May, reduced the larval population from 65 to 16 per square foot of turf by 26th June and remained effective long enough to reduce the average population of the next generation, which appeared in July and August, from 72–75 to 2 per sq. ft. by 18th September. In preliminary experiments in early August, BHC (benzene hexachloride) in dusts containing 5·75 per cent. γ isomer and applied at 8–24 lb. per acre gave no control by late September. DDT dissolved in kerosene and applied by a mist blower at the rate of 1·6 lb. DDT per acre completely protected vegetation from attack by adults for three weeks, after which they occurred in reduced numbers.

In an account of field investigations on the control of *Limonius ectypus*, Say, on potato (pp. 56–59), D. E. Greenwood reports that D-D mixture (1,2-dichlorpropane and 1,3-dichlorpropene), applied with a hand injector in late April to typical potato soils in a physical condition suitable for planting, resulted in no larval feeding on seed-pieces and only a trace of injury on tubers harvested in late September, rather earlier than normal, when used at 25 or 40 U.S. gals. per acre and a small amount of larval feeding and 16 per cent. total injury at harvest when used at 12 U.S. gals. There was rather heavy feeding on seed-pieces and 30 per cent. injury at harvest on untreated plots, and it is considered that dosages of 12–25 U.S. gals. per acre are desirable for Connecticut soils. In preliminary greenhouse studies, BHC in a dilute dust, mixed with the top five inches of soil at the rate of 1 lb. technical BHC (10 per cent. γ isomer) per acre, killed all wireworms confined in the treated soil. Larvae that were moved to fresh soil within two hours did not develop symptoms of poisoning when kept under observation for several weeks, whereas those kept in the treated soil for more than two hours showed symptoms within 24–48 hours and died within 10–21 days. Death appeared to occur much sooner, usually in about 8–10 days, when the larvae were kept continuously in the treated soil. In field tests, applications of 1·3–6 lb. BHC per acre in a dilute dust to the open furrows by means of a rotary hand duster before the seed-pieces were dropped in them resulted in almost perfect commercial control, tubers in untreated soil showing 71 per cent. injury. Treatment at rates down to 0·33 lb. BHC gave less control, but resulted in distinctly less injury than no treatment, and reduced dosages might be expected to give commercial control under more normal conditions of infestation. The success of this treatment depends on the migration of a large proportion of the larvae to the seed-pieces for the initial spring feeding period, and where other food is available, as when potatoes follow a cover crop, the response of wireworms to the seed-pieces is negligible and row treatment is not advised. Broadcast treatments, made by applying dilute dusts to the soil with a grain drill and thoroughly disking the soil immediately afterwards, were found to be an effective way of incorporating BHC into the soil to a depth of 5–6 inches. Good commercial control was obtained in plots in fields showing 70–79 per cent. total injury when 2·5–5 lb. BHC per acre was applied in 200–250 lb. dust, often on the day of planting. Seed-piece treatment consisting of a deposit of crude BHC on cut and calloused surfaces, either from a 50 per cent. concentrate dust or from a dip made from a wettable 50 per cent. concentrate, did not give good commercial control, but materially reduced the losses, especially as regards the number of tubers showing extreme wireworm feeding, and such treatment would probably prevent wireworms from causing undue losses and increasing to large numbers where populations are fairly low. Putting wheat-bran baits containing 0·01 per cent. BHC beside the seed-pieces involved considerable work and gave about the same control as seed-piece treatment. It proved to be the least desirable method of application and will probably find little use. The BHC used had a strong musty odour, and the results indicated that tubers grown in soil receiving row or broadcast treatment with more than 1 or 2·5 lb. per acre, respectively, acquire this odour. Treatments of soil to be used for growing potatoes in the same year should be on a limited scale until further data are available. Since the insecticidal efficiency of BHC in soil remains high for months, treatment in the previous autumn might be advantageous.

In experiments described by N. Woodruff & N. Turner (pp. 60–67), DDT, BHC and DDD (dichlordiphenyldichlorethane) were applied at equal concentrations in schedules of sprays for the control of flea-beetles [*Epitrix cucumeris*, Harr.] and leafhoppers [*Empoasca fabae*, Harr.] on potato. Two commercial 50 per cent. DDT spray powders of equal particle size that differed in laboratory toxicity tests also gave divergent results in the field, one affording satisfactory control of both insects at 1 lb. DDT per 100 U.S. gals. and the other much less, possibly owing to some effect of diluent or additive. A 25 per cent. DDT emulsion concentrate was inferior to both against *Epitrix* and to the first against *Empoasca*. There was little difference in yields, owing to soil heterogeneity and tuber rot. Two water-miscible spray concentrates containing 25 and 70 per cent. mixed isomers of DDT with an emulsifier proved much inferior to the emulsion concentrate. BHC and DDD gave about the same results as the mixed isomers against *Epitrix*, but were considerably more effective against *Empoasca*, DDD being the better of the two, though it was inferior to any of the first three DDT preparations. When two preparations of 50 per cent. DDT in diatomaceous earth were compared, the one that contained a wetting agent (Vatsol OT) proved less effective than the one that did not. Laboratory tests indicated that this was due to reduced deposit.

In field tests of dusts against the Mexican bean beetle [*Epilachna varivestis*, Muls.] on beans, described by Turner (pp. 68–69), the percentage reductions in numbers of larvae were, respectively, 69·7, 93·6, 93·9 and 99·7 for cubé at concentrations giving 0·125, 0·25, 0·5 and 1 per cent. rotenone, 69·1, 42·8, 88·9 and 76·1 for DDT at 0·5, 1, 2 and 4 per cent., 96·3, 97·8, 98·8 and 99·4 for methoxy-DDT (dimethoxydiphenyltrichlorethane) and 27·2, 8·3, 34·6 and 33·9 for DDD, both at the same concentrations as DDT, and 20·5, 80·4, 92·4 and 98·4 for 1·25, 2·5. 5 and 10 per cent. hydroxypentamethylflavan.

P. Garman & J. F. Townsend describe experiments with acaricides used alone or with DDT in orchard sprays (pp. 76–78). The principal mite in the orchards was *Paratetranychus pilosus*, C. & F. DN–111 (dicyclohexylamine salt of dinitro-o-cyclohexylphenol) gave satisfactory control when combined with DDT, and the combination was apparently safe on apples and caused no injury to peach in preliminary tests late in the season. Several applications of xanthone combined with the usual flocculator and spreader and added to DDT also gave satisfactory control. Syndeet (an alkyl ester of β naphthol with DDT) was inferior to xanthone or 1 per cent. summer oil. Laboratory and small-scale field tests with *Tetranychus bimaculatus*, Harvey, and *P. pilosus* indicated that hexaethyl tetraphosphate showed promise against the eggs and adults. Spydertox (a rotenone preparation) was also promising in both laboratory and field and nearly as effective against eggs and adults of *Paratetranychus* as DN-111.

Townsend (pp. 79–82) gives an account of observations on the European apple sawfly [*Hoplocampa testudinea*, Klug] in 1946, made in view of its potential importance as an orchard pest [*cf.* **35** 357]. It is now known to be distributed throughout Fairfield County and the southern part of New Haven County, the heaviest infestations being chiefly in individual trees of odd varieties that do not receive full spray treatments or in orchard blocks where the insecticide coverage is apparently inadequate, as indicated by damage from other pests. It seems possible that varieties with a long blooming period and a heavy set of fruit are particularly suitable for oviposition and full development of the larvae, and apples in clusters, being more difficult to spray thoroughly than individual apples, may also be more readily infested by the migrating larvae. As migration occurs before the normal time for the hand-thinning of apples, blossom-thinning sprays may prove useful where infestation is expected in varieties that set heavily. Some of the larvae were observed to tunnel directly under the skin of the apple from the oviposition slit, so that they were not exposed to contact with insecticidal residues during the first part of their development, but migration before development was complete appeared to be rather general. The irregularity of infestation, as shown in 1945 and 1946, made diagnosis of an infestation in time to take action against it difficult. The appearance of frass, which is not usually deposited in quantity on the outside of the fruit until the larvae start tunnelling deeply, is perhaps the first practicable indication of current infestation, and when this appears there may still be time to control the migrating larvae, by means of an extra spray with the regular insecticide used at a higher concentration than usual or possibly with derris dust. Other possible means of control include spraying the apple foliage before blooming to kill the adults. In preliminary cage tests, foliage that had been sprayed with either DDT or BHC proved lethal ; a fumigating action of BHC was suspected in the type of cage used.

In tests on the use of DDT on apple to control the codling moth [*Cydia pomonella*, L.], made in connection with reduced-schedule treatments against other pests [*cf.* **37** 373, etc.] and described by Garman (pp. 85–86), the addition of 2 lb. 50 per cent. DDT wettable powder per 100 U.S. gals. to the last of the sprays of 6 lb. lead arsenate, 1½ lb. bentonite, ½ lb. skim milk powder, 2 lb. Fermate [ferric dimethyl dithiocarbamate] and ½ U.S. gal. white mineral oil per 100 U.S. gals., applied about 20th June, considerably reduced the damage. A further DDT treatment on 11th July, after damage by *C. pomonella* had appeared on the fruit, did not increase control, and this by itself was ineffective, although injury was nowhere so severe as in 1945. It appears that the addition of DDT to the last treatment in the reduced schedule, applied soon after the middle of June, might give adequate control of light infestations of *C. pomonella* in Connecticut.

In further experiments described by Garman (pp. 87–88), in which all amounts are per 100 U.S. gals., apple trees received a delayed dormant spray of a sodium salt of dinitro-o-cresol on 6th April and either a non-arsenical schedule comprising 1 lb. BHC (10 per cent. γ isomer) and 4 lb. sulphur on 24th April, the same with 1 and 2 lb. bentonite on 14th and 21st May, respectively, 8 oz. BHC with 4 lb. sulphur on 6th June, 1 lb. BHC, 1 lb. DN-111 (dicyclohexylamine salt of dinitro-o-cyclohexylphenol), 1 lb. DDT and 4 lb. sulphur on 17th June, the same without the BHC on 3rd July and the same without BHC or DN-111 on 5th August, or an arsenical schedule of 3 lb. lead arsenate with 4 lb. sulphur and 3 lb. lime on the first five dates and a similar spray with only 2 lb. lead arsenate on the last two. Control of the curculio [*Conotrachelus nenuphar*, Hbst.] was usually higher by the BHC than by lead arsenate, though some further improvement was desirable ; on the non-arsenical plots, other insects and diseases were successfully controlled, and mites (*Paratetranychus pilosus*), which became numerous on the lead-arsenate trees, were kept at a low level throughout the season. Foliage and fruit were in excellent condition at harvest in these plots, but many leaves had dropped in the others. No odour was noticeable in or on apples picked between 20th August and 1st September, two months after the last application of BHC, and the odour disappeared from the trees themselves in about a month.

Experiments on the control of the oriental fruit moth [*Cydia molesta*, Busck] on peach by parasites and insecticides are reported by Garman & W. T. Brigham (pp. 89–91). In one orchard in which *Macrocentrus ancylivorus*, Rohw., was released in considerable numbers in one block of trees and sprays or dusts applied in others, the percentages of fruits damaged were 21·21 following parasite release, 4·01 for a dust of 2·5 per cent. DDT and sulphur on 5th and 27th July and 5th August, 7·3 and 7·92 for sprays of 3 and 1·5 lb. zinc nicotine thiocyanate per 100 U.S. gals. on 5th July and 5th August and 13·98 and 19·23 for the same with 4 lb. wettable sulphur. Injury to foliage resulted from the thiocyanate spray and the DDT dust, the latter probably owing to a small amount of bentonite present in it. In another orchard in which DDT treatments also proved superior to parasite liberations and large numbers of parasites were recovered, there was considerable parasitism in the section sprayed and dusted with DDT, and a conspicuous decline in parasitism in both sections as the season advanced. The recoveries seemed to indicate that the elimination of *Macrocentrus* was far from complete in the DDT section. In still another orchard, parasite release appeared to give better control than DDT.

In view of the importance of DDT residues in controlling pests of plants, the factors affecting their toxicity were studied, and the results are summarised by Turner & Woodruff (pp. 93–97). When glass slides were sprayed for various periods with water, kerosene and a solvent (Velsicol AR–50) and weighed immediately after spraying, it was found that the deposit of water was much greater than that of the AR-50, and that of kerosene rather less, probably owing to differences in droplet size. Glass and wood plates and wire screens were then sprayed with DDT in water, kerosene or AR-50, dried for 24 hours and exposed to house-flies [*Musca domestica*, L.]. The deposit from the water suspension was the most toxic and that from the solution in AR-50 usually the least. The addition of a wetting agent (Vatsol) to the water suspension reduced the deposit, but the smaller deposits were about as toxic as the larger deposits without the wetting agent. In a test in which glass slides that had been sprayed with DDT in suspension, solution or emulsified solution were exposed to flies four times at intervals of two days, there was a marked loss in toxicity of the residues with successive exposures. However, similar slides that were not exposed to flies until the last day of the test also showed very low toxicity, and it is concluded that this test did not show that removal of DDT by the test insects was responsible for the losses in toxicity.

In experiments on the relative toxicity of nicotine sulphate and nicotinium compounds, described by Turner & D. H. Saunders (pp. 98–110), alkyl, aralkyl, dialkyl and diaralkyl nicotinium salts, mixed nicotinium and hydrogen-iodide salts and nicotine 2,4-dinitrophenolate were tested as contact sprays against *Aphis fabae*, Scop. (*rumicis*, auct.) reared on nasturtium in the greenhouse. All dilutions were made on the basis of nicotine content and no wetting or conditioning agents were added. The water-soluble nicotiniums were dissolved directly in distilled water and compared with nicotine sulphate in the same medium, and compounds not soluble in water were dissolved in acetone and the solution was added to distilled water, a similar proportion of acetone being added to the standard nicotine-sulphate solution. Nicotine 2,4-dinitrophenolate and 1-benzyl-3-[2-(1-methylpyrrolidylhydriodide)]pyridinium chloride were more toxic than nicotine sulphate, and dodecylnicotinium thiocyanate, didodecylnicotinium dithiocyanate and ethylnicotinium iodide were less toxic than nicotine sulphate at the dosages used but would be expected to surpass it at high dosages. Dilaurylnicotinium dipicrate and hexadecylnicotinium thiocyanate both increased rapidly in toxicity as the dosage increased, but required so high a dose for control equal to that by nicotine sulphate that this was of little advantage. The other materials were inferior to nicotine sulphate.

Although none of the compounds tested was promising as a substitute for the nicotine sulphate, the data were examined in an attempt to explain differences in toxicity between it and the nicotinium compounds and between the various nicotiniums. In all of the latter the modification in the nicotine molecule is additive on the nitrogen in one or both of the rings. The direct addition of an alkyl halide to the trivalent nitrogen in the pyrollidine ring to form a quaternary ammonium salt reduced toxicity sharply, and an additional alkyl halide on the nitrogen in the pyridine ring reduced it still further, suggesting that the two nitrogen atoms are very important in the toxicity of nicotine. The combination of nicotinium and hydrogen iodide salts in the same molecule generally failed to produce any substantial toxicity. Although additions to nicotine reduced toxicity, they did so to different degrees. In the bromides, toxicity increased from methyl to dodecyl and then decreased as the length of the radical was further increased; in the iodides, there was a less regular increase in potency and the ethyl nicotinium iodide was the most toxic of the series; and in the thiocyanates, the dodecyl compound was again the most toxic of the series. It thus appears that the toxicity of these nicotiniums was controlled more by the nature of the added radicals than by the fact that the nicotine molecule was present. Substitution of the benzyl radical for a straight chain had a variable effect; the benzyl compound was slightly more toxic than the dodecyl in the thiocyanates and much less toxic in the chlorides, bromides and oleates. Substitution on the benzene ring also affected toxicity; o-chlorbenzylnicotinium thiocyanate was less toxic than benzylnicotinium thiocyanate, and the same was true of the bromides. Parachlorbenzylnicotinium chloride and 2,4-dichlorbenzylnicotinium chloride were both less toxic than the benzyl chloride but the 3,4-compound was one of the most toxic chlorides tested. Paranitrobenzylnicotinium bromide was less toxic than the benzyl bromide, but in the thiocyanates and palmitates, the paranitrobenzyl compounds were more toxic than the benzyl ones. Synthesis of compounds containing two molecules of nicotine did not result in high toxicity, such molecules being less toxic than some of the smaller and simpler ones. Although the series of compounds available for comparison was not large, the iodides were generally less toxic than the corresponding bromides, two of the chlorides were less toxic than the similar bromides and one was slightly more toxic, the thiocyanates were much more toxic than the halogen compounds, the propionates, oleates, stearates, palmitates, laurates, valerates and paratoluene sulphonates were not outstanding in toxicity and the acetates, picrates and sulphates were also mediocre. The toxicity of the nicotine molecule was not dominant in the nicotiniums, but it influenced toxicity, dodecylnicotinium thiocyanate being much more toxic than dodecylisoquinolinium thiocyanate. Since isoquinoline has only one nitrogen atom, this is additional evidence of the importance of the two nitrogen atoms in nicotine. The nicotinium compounds differ from nicotine sulphate in physical as well as chemical properties. Most were soluble in water at the concentrations used, but the water-insoluble benzyl nicotinium thiocyanate was more toxic than the soluble butyl, octyl, cetyl and octadecyl thiocyanates, although the two most toxic nicotiniums were water-soluble. Solubility in water therefore appears to have considerably less effect than molecular structure on toxicity. There was also no correlation between the contact angles of aqueous solutions of several nicotiniums and their toxicity.

PUTMAN (W. L.). **Laboratory Technique for testing Codling Moth Insecticides.**—*Canad. Ent.* **81** no. 4 pp. 85–93, 5 figs., 1 ref. Guelph, Ont., 1949.

Methods and equipment designed in Ontario for the laboratory investigation of DDT or other insecticides for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., are described. The spraying equipment comprised a device for rotating single apples in spray discharged from a nozzle ; separate mountings allowed adjustment of the height of the apple or nozzle and the distance between them. The apple was rotated at 30 revolutions per minute, since there was a tendency for the spray to be thrown off it at higher rates. Suspensions and unstable emulsions left in the spray gun after a test sometimes tended to separate out, and a movable metal shield was therefore fitted between the nozzle and the fruit to deflect the first spray discharge downwards. The effect of weathering on spray deposits was simulated by passing the apples, hanging from a rack mounted on a trolley drawn by means of an endless belt at a rate of six inches per minute, between two nozzles that sprayed them with water.

Eggs of *C. pomonella* were obtained from adults reared from larvae collected in autumn. For satisfactory results, the larvae had to be kept at 35–37°F. until about mid-February, and batches were then transferred to glass jars and kept in an incubator at 80°F. and high relative humidity. Once emergence had begun, it was controlled by transferring the jars between the incubator and the refrigerator. The oviposition cages were wire-screen cylinders, each standing on waxed paper on glass and covered by a piece of waxed paper over which was fixed another piece of glass. Each cage contained a roll of wet dental cotton, which, with the pieces of waxed paper, was renewed daily ; most eggs were deposited on the lower paper near the dental cotton. About 75 moths were placed in each of the cages, which were then kept at 80°F. and 85–90 per cent. relative humidity. Egg-production was erratic, and no conditions of temperature, humidity and intensity or periodicity of light gave consistently good results. Moths originating from different localities differed greatly in this respect, but since the inmates of a cage usually continued to oviposit freely once they had started to do so, and since many infertile eggs were laid, failure to mate was probably the chief factor involved. Oviposition appeared to be stimulated when a can of over-ripe apples was placed in the incubator and, despite the fact that the moths were kept at constant temperature, by sudden changes in the weather ; barometric pressure may have had some influence [*cf. R.A.E.*, A **33** 184].

In preparation for infesting the fruit, pieces of waxed paper bearing a total of ten fertile eggs were fixed on a pin and kept in closed jars containing moist blotting paper until hatching was imminent. Apples of two varieties that had been kept in cold storage were used, and lead-arsenate residues were removed from them by washing in dilute hydrochloric acid. The epidermal grease of Jonathan apples had to be removed by immersion in acetone, since it was toxic to the larvae and reduced the rate of establishment. The cavities at the ends of the apple were filled with wax and, after it had been treated, the egg-papers were pinned to the upper side ; a piece of tree-banding adhesive put on the point prevented entrance of larvae at the side of the pin. The fruit was kept at 77°F. and 85–90 per cent. relative humidity, and any fumigant action of the insecticide prevented by air circulation. The degree of larval establishment in both sprayed and unsprayed fruit varied from day to day, and valid comparisons could be made only between tests carried out on the same day, but the relative effectiveness of the materials tested was generally the same in successive tests.

FORSTER (E. W.). **On the Taxonomic Status of the European Spruce Sawfly, *Gilpinia hercyniae* (Htg.) (Hymenoptera, Diprionidae).**—*Canad. Ent.* **81** no. 5 pp. 112–113, 8 refs. Guelph, Ont., 1949.

Comparison of Canadian specimens of *Gilpinia* with original specimens from the Hartig collection selected as lectotypes and paratypes of *G. hercyniae*, Htg., and *G. polytoma*, Htg., confirmed the view that these species are distinct and that the one introduced into Canada from Europe is *G. hercyniae* [*R.A.E.*, A **30** 341]. Both are widespread in Europe, but *G. polytoma* reproduces by arrhenotokous parthenogenesis, and the sex ratio is 1 : 1, whereas *G. hercyniae* reproduces by thelytokous parthenogenesis and males are very rare.

MORRIS (R. F.). **Differentiation by Small Mammal Predators between sound and empty Cocoons of the European Spruce Sawfly.**—*Canad. Ent.* **81** no. 5 pp. 114–120, 1 fig., 8 refs. Guelph, Ont., 1949.

The following is based on the author's summary of observations and experiments in eastern Canada. Small mammal species differ widely in their ability to distinguish between sound cocoons of the spruce sawfly, *Gilpinia hercyniae*, Htg., and those that are dead or are emptied by parasites [*R.A.E.*, A **31** 213–214]. This ability is highly developed in the shrews (*Sorex* and *Blarina*), moderately developed in the mice (*Peromyscus*), and practically lacking in the voles (*Clethrionomys*). Predatory efficiency in selecting cocoons is closely related to food habits, the more insectivorous the species, the more marked its ability to differentiate between cocoons. Shrews appear to depend largely on their sense of smell for recognising sound cocoons. Mammals that cannot distinguish empty, intact cocoons use visual or tactile responses in recognising cocoons that have a fairly large opening in them. Owing to these specific differences, and because cocoons are frequently hoarded in places where they are likely to be overlooked and large numbers of mature larvae are eaten before they have constructed cocoons, there is little justification for analyses of the value of different control factors and of their mutual interference based on cocoon collections alone.

HANDFORD (R. H.). *Lygus campestris* (**L.**) **: a new Pest of Carrot Seed Crops.**—*Canad. Ent.* **81** no. 5 pp. 123–126, 1 ref. Guelph, Ont., 1949.

Yields of carrot seed in the Grand Forks district of British Columbia were greatly reduced during 1947 and 1948, largely as a result of infestation by *Lygus campestris*, L. This Mirid is a minor pest of carrot seed crops in Idaho, where it also attacks lucerne. Some observations on its life-history in British

Columbia were made during periodical visits to the infested area. Adults thought to have overwintered were active by 15th April, before the carrots were planted, and occurred on the new carrot crops by 19th May. Large numbers of eggs were found embedded in the petioles on 5th June, and there were smaller numbers in the pedicels and main stems. Occasional first-instar nymphs were found two days later. Nymphs were most abundant about 24th June, when a few first-generation adults were also present, and adults predominated by 7th July. Second-generation nymphs formed the bulk of the population by 11th August, and second-generation adults by 26th August, when total numbers were greatly reduced, indicating that only two generations occur each year. *L. campestris* was at all times scarce on carrots grown for consumption, even where they were situated within a few yards of the seed crops.

In experiments on control, plots on five properties were dusted with a mixture containing 7 per cent. DDT and 0·06 per cent. pyrethrum on 4th–5th June and 5 per cent. DDT on 22nd June and 12th August, all at rates of 30–38 lb. per acre. Early in the season, the adults occurred among the petioles of the young leaves, and direct counts were made of the number present on the experimental plants. Later, they became most numerous in the flower heads, where they and the nymphs feed on the pedicels and developing seeds, and their numbers could be better determined by sweeping, though direct counts were more satisfactory for the nymphs. The first application of DDT gave 80–98 per cent. control and the second 95–99 per cent. ; the treated plants were then 6–8 ins. taller than the untreated ones and produced more flower heads. The third application was probably rather less effective, but no estimates of control were made. The effect of the deposits on bugs entering the treated area was tested by putting ten nymphs in a vial with a treated seed head and ten in a vial with an untreated one on 24th June. Some of those with the treated head had died in 16 hours and all in 48 ; the other ten were alive after 48 hours. In the field, populations in adjacent dusted and undusted plots still showed marked differences 3–6 weeks after treatment. The yields of cleaned seed averaged 241 lb. per acre on the treated plots and 101 lb. on the untreated.

The early feeding of the overwintered adults appeared to stunt the plants to such an extent that they only partially recovered, even when subsequent growth conditions were favourable. It is therefore possible that an earlier application, made when the adults first appear on the plants, would give still greater increases in yield. Although the increase obtained in the tests was sufficient to justify control, it did not raise the total yield to the previous level, and factors other than insects, such as soil and weather, may also be involved.

STEPHEN (W. P.) & BIRD (R. D.). **The Effect of barometric Pressure upon Oviposition of the imported Cabbageworm,** *Pieris rapae* (**L.**).—*Canad. Ent.* **81** no. 5 pp. 132. Guelph, Ont., 1949.

During ecological studies of insects in vegetable gardens in Manitoba in 1948, adults of *Pieris rapae*, L., were observed to feed and move about freely on warm, clear days, and to become active about the plants, where they appeared to be chiefly ovipositing, on overcast days, especially before rain. The effect of barometric pressure on the rate of oviposition of newly caught adults was therefore investigated by exposing a fresh cabbage leaf to the butterflies for an hour in a jar in which a known pressure was produced, removing and counting the eggs, and returning the leaf to the same butterflies for a further hour at a higher or lower pressure. The high pressures tested ranged from 988 to 1,030 millibars and the low ones from 898 to 942 millibars ; the numbers of eggs deposited per female under these conditions were 0·3–6 and 13·6–43·7, respectively. The number laid was not influenced by the order in which the females were exposed to the two pressures.

Large numbers of adults of *P. rapae* migrate throughout southern Manitoba during July–August, and their movements appear to be greatly influenced by barometric pressure. During periods of high pressure, they travel long distances, and alternating periods of high and low pressure would therefore promote dispersal and oviposition over wide areas.

BUTCHER (J. W.) & HODSON (A. C.). **Biological and ecological Studies on some Lepidopterous Bud and Shoot Insects of Jack Pine (Lepidoptera-Olethreutidae).**—*Canad. Ent.* **81** no. 7 pp. 161–173, 5 figs., 8 refs. Guelph, Ont., 1949.

A moth observed damaging jack pine [*Pinus banksiana*] in Minnesota in 1942, and at first thought to be *Rhyacionia frustrana*, Comst., was subsequently identified as *Eucosma sonomana*, Kearf., which was originally described from California in 1907 and has been recorded from *P. ponderosa* and *Picea engelmanni* in Montana. It was later found to occur on *P. banksiana* in many parts of Minnesota, and scattered injury by it was observed in Wisconsin and Michigan. Observations on its bionomics were made from 17th June to 25th August in 1947 and during the spring and early summer of 1948 in an experimental plantation of *P. banksiana* at Cloquet, Minnesota. Adults were not observed in 1947, but were present on 13th May in 1948. Phenological evidence indicates that emergence in 1947 took place in late May and early June. In 1948, when the growing season was more advanced than in 1947, adult activity reached a peak in the middle of May. No eggs were found in the field ; in the laboratory, a few were deposited on the sheaths of the needles, but did not hatch. First-instar larvae were found in the field on 25th June in 1947 and 11th June in 1948. The larvae enter the shoots, generally about 6–8 ins. above the base of the current season's growth, and feed in the pith, moving first downwards to a point 1–3 ins. above the base and then upwards for 1·5–2 ins. When fully grown, they girdle the shoot, leaving only the epidermis, and then move upwards for another 0·5–2 ins., and bore an exit hole ; the girdling tends to dry out the upper part of the shoot and possibly reduces the flow of pitch at the exit hole. Two or three larvae can complete their development in a large shoot, but usually only one in a small one. Pupation takes place in silken cocoons in the litter after a prepupal period that lasted 60–72 hours in the laboratory. The pupae overwinter. Adults did not emerge from field-collected pupae that were kept at 70°F. and 100 per cent. relative humidity for eight months, but some kept at 5°C. [41°F.] for 3–3·5 months and then transferred to room temperature gave rise to adults within eight days. An unidentified species of *Glypta* was reared from 19 of 80 pupae. The girdled shoots tend to break during high winds, and the terminal portions die. The damage can also be recognised by the minute emergence holes and by the yellowing and subsequent browning of the upper part of the shoots, which can be broken by shaking the tree. Since *P. banksiana* grows rapidly when young and shows a marked tendency to replace the terminal shoot by one of the upper laterals, the value of the mature timber is not likely to be affected unless repeated attacks occur. Lateral branches are also attacked, however, and many trees in the plantation presented a bushy appearance as a result of persistent breakage of the terminal branches and failure of any one lateral to become dominant. The injured base of the terminal shoot may provide an entry for disease organisms.

A brief analysis is included of some ecological factors influencing the incidence of attack. The population increase expressed in terms of average number of attacks per tree over the three-year period for which figures are available bore a straight-line relationship to tree age and size, and there was no indication that the build-up of the species was adversely affected by natural controls. Trees grown from seed imported from different places in the Lake States and Canada exhibited a differential incidence in point of number of attacks per tree with respect to origin, but their diversity with respect to age, size and site, which may also be of importance, was not considered.

Notes are also given on the bionomics and importance of *Rhyacionia* (*Petrova*) *albicapitana*, Busck, and *R.* (*P.*) *pallipennis*, McD., which also occurred on *P. banksiana* in the plantation. The former is generally distributed throughout the range of that pine in Minnesota, Wisconsin, Michigan and Canada. The larvae form pitch blisters at the base of the young shoots in which they feed, overwinter and pupate. In 1948, pupation took place as early as 1st May, and adults were very numerous by 11th June. Scar tissue generally forms over the emergence holes of the larvae, and little damage results from the infestation. In many cases, however, the larval burrows enter the pith, and the shoots later break and droop, but do not always die. This causes a deformity at the top of the tree and also provides a point of weakness at which breakage may subsequently occur. A Eulophid, *Hyssopiscus* (*Hyssopus*) *evetriae*, Gir., was reared from the pitch nodules, and superparasitism appeared to occur.

R. pallipennis, which was described from specimens taken in Quebec, Manitoba and Alberta, and had not previously been recorded in the United States, was found in several districts in Minnesota. The larvae mine the terminal buds of *P. banksiana* and overwinter in the large central bud of the terminal group. In 1948, development was resumed in the second or third week in May, and pupation was completed by the first week in June. Adult activity was at its peak by the third week of June. The pupae were heavily parasitised, the species reared from them being *Campoplex argenteus*, Prov., *Diplazon tibiatorius*, Thnb., *Phaeogenes* sp., *Ephialtes* (*Calliephialtes*) *comstocki*, Cress., *Apanteles petrovae*, Walley, and *Eurytoma* sp. As a result of infestation by *R. pallipennis*, the terminal buds fail to develop and in many cases the entire whorl is destroyed. The main growth is continued by a lateral shoot, and the subsequent rotting of the terminal bud permits the entry of disease organisms.

MUSGRAVE (A. J.). **The Use of a fluorescent Material for marking and detecting Insects.**—*Canad. Ent.* **81** no. 7 p. 173. Guelph, Ont., 1949.

During tests of insecticides on leguminous crops, it became desirable to mark honey bees at the hive and at the flowers. Promising results were obtained with fluorescein applied as a dust to a wire-mesh frame through which the bees had to pass when leaving the hive or to dandelion flowers that were visited by them. Its presence on the bees could be detected by sight or, in a quantity as small as 1 mmg., by the use of a Coleman's photofluorometer. The method of making the solution for the latter and taking the readings is briefly described.

NEILSON (C. L.). **Biology and seasonal History of** *Pleurotropis utahensis* **Crawford, a Parasite of the Wheat Stem Sawfly.**—*Canad. Ent.* **81** no. 7 pp. 174–180, 1 fig., 7 refs. Guelph, Ont., 1949.

The Eulophid, *Pleurotropis utahensis*, Cwfd., has been recorded as a parasite of *Cephus cinctus*, Nort., in Utah, North Dakota, Montana and the Prairie Provinces of Canada ; its only other known host is *Agromyza parvicornis*, Lw., from which the holotype female was reared in Utah. In observations in Canada in 1935–46, it was found to occur throughout the range of *C. cinctus* in Alberta, Saskatchewan and Manitoba. It has been reared from it in various wild grasses, as well as spring wheat and autumn rye, and the percentage of parasitism is lower in wheat than in the grasses. Thus, it was 1–2 in wheat and 50–75 in *Bromus inermis*, *Agropyrum smithii* and *A. trachycaulum* growing nearby in Alberta in various years. The mean numbers of parasites reared per host larva in stubs of these three grasses and spring wheat were 3·98, 5·54, 4·32 and 3, respectively. Of the two species of *Agropyrum*, *A. smithii* is the commoner in the areas infested by *C. cinctus*. The optimum conditions for parasitism appear to be provided by thick stands of native grasses situated in depressions in which water occasionally accumulates, so that the atmosphere is very humid.

The *Cephus* larvae are most frequently parasitised when in the first or second instar, but the third instar is also attacked, and one egg was found to contain a developing parasite egg. Larvae in grass stems were attacked when caged with both male and female parasites, but not when caged with unfertilised females only. No eggs were found in females dissected after being kept without food for 2–12 days after emergence at laboratory temperatures, or for 21 days at 5, 10 or 25°C. [41, 50 or 77°F.] and 80 per cent. relative humidity. The eggs are deposited in the fatty tissue of the host through the wall of the stem, and hatch within five days. As many as 30 were dissected from a single female, which might already have deposited some. The adult parasites make only very short flights ; activity practically ceased during rainfall accompanied by low temperatures, and was not resumed until the grass was again dry. Mortality did not differ appreciably among freshly-emerged adults kept at 5 and 10°C. for 48 days, but 19 and 100 per cent. died in 21 days at 25°C. when the relative humidities were 80 and 90 per cent., respectively. The life span of the adults therefore probably varies in different seasons and localities. Larvae collected from *A. smithii* on 11th April, 1946, had an undercooling point of about −22·5°C. [−8·5°F.], so that freezing weather is unlikely to cause much mortality. The longest flight period observed in southern Alberta extended from the first week of June until the first week of August. A peak was usually reached at the end of June and beginning of July; it was 7–12 and at least 14 days later than the peaks of flight of *Cephus* emerging from wild grasses and from wheat, respectively, and occurred when larvae of the latter in wheat were in the second, third or fourth instar and those in the grasses were chiefly in the first or second. Females were 2·28, 3·10 and 4·14 times as numerous as males among parasites reared from *B. inermis*, *A. trachycaulum* and *A. smithii* at 77°F. and 80 per cent. relative humidity, but only 1·8 times as numerous among those reared from *B. inermis* at 55·4°F. When several parasites were present in one stub, they comprised both sexes or females only.

The larvae develop within the host until the autumn, and then emerge from it, usually after it has cut the stem and constructed its cocoon, consume the remaining soft tissues, and overwinter in its cocoon. They enter a prepupal stage when the temperature begins to rise in spring, and usually pupate in the second half of April, though pupation may be delayed until as late as the last week in June. Adults do not emerge simultaneously from all the pupae in a single stub. Larvae that were collected in *Bromus* stubs in autumn, stored in the laboratory at 6°C. [42·8°F.], and transferred on 12th January to a constant temperature of 77°F. and a relative humidity of 80 per cent. pupated after a mean period of 18·5 days, whereas others collected on 22nd March and kept at 55·4°F. pupated after 17·5 days ; the corresponding means for the pupal stage were 13·1 and 20·2 days. Larvae collected from *A. smithii* and *A. trachycaulum* in March and reared under the same conditions pupated after similar periods, but the pupal stage was shorter in those from *A. trachycaulum*.

HAMMOND (G. H.). **The Bald-faced Hornet,** *Dolichovespula maculata* **(L.), as a Predator of the White-grub Parasite** *Microphthalma disjuncta* **Wied. in Hastings County, Ontario.**—*Canad. Ent.* **81** no. 7 p. 181. Guelph, Ont., 1949.

Adults of *Microphthalma disjuncta*, Wied., an internal parasite of *Lachnosterna* (*Phyllophaga*) spp., were observed on 20th June flying in numbers in a rough pasture in Ontario that had been seriously damaged by second-year white grubs during the previous year. They were most numerous over low-growing plants, such as *Juniperus communis*. *Vespula* (*Dolichovespula*) *maculata*, L., was observed carrying off individuals from one such swarm, presumably to provision its nests. In years in which the wasp is abundant, this habit might prove undesirable.

HAMMOND (G. H.). **Benzene Hexachloride (BHC) as a rapid Control Agent for White Grubs** (*Phyllophaga* **spp.**).—*Canad. Ent.* **81** no. 8 pp. 200–201, 1 ref. Guelph, Ont., 1949.

BHC (benzene hexachloride) was tested against second-year larvae of *Lachnosterna* (*Phyllophaga*) spp. in experimental plots on well-drained heavily infested pasture land in Ontario during 1948. The pasture was situated on sandy soil containing relatively little organic matter over a considerable depth of sub-soil. Sprays of a miscible BHC concentrate containing 25 per cent. γ isomer were applied at rates of 0·25, 0·5, 1, 2, 4 and 8 lb. γ BHC per acre on 14th June, before heavy feeding had begun; the pasture, which was not subsequently watered, was then lightly grazed by cattle. Counts of larvae were made on 27th July, when untreated pastures and meadows showed considerable injury, 29th July and 1st September. Dead larvae were found in numbers only during the first count, indicating that mortality occurred principally during early or mid-July, either because soil temperatures were most favourable then or, more probably, because the larvae were then most susceptible to contact with BHC. On the basis of comparative populations in treated and untreated plots, only rates of 4 or 8 lb. γ BHC per acre gave marked control. The sod was in better condition in all the treated plots than in the controls, however, though a considerable amount of sod that received 0·25–1 lb. per acre was detached below the surface. Sod that received 2 lb. per acre showed 10 per cent. injury, but none was cut off. The growth of grass was best following treatment at the highest rate.

SIMMONDS (F. J.). **Insects attacking** *Cordia macrostachya* **(Jacq.) Roem. & Schult. in the West Indies. 1.** *Physonota alutacea* **Boh. (Coleoptera, Cassididae).**—*Canad. Ent.* **81** no. 8 pp. 185–199, 5 figs., 6 refs. Guelph, Ont., 1949.

In connection with the proposed attempt to control the noxious weed, *Cordia macrostachya*, in Mauritius by the introduction of suitable insects that attack it in Trinidad [*R.A.E.*, A **36** 424; **38** 190, 191], the bionomics and feeding habits of *Physonota alutacea*, Boh., were studied in Trinidad during 1946–47. This Cassidid, all stages of which are briefly described, was observed in 1944 on an estate on which it occurred in derelict areas secondarily invaded by *Cordia*, and it has since been found in other ecologically similar areas, but it does not occur throughout the range of its food-plants on the island. It appears to be specific to *C. macrostachya*, since in experiments in which adults (starved for two days) and larvae in the first, third and fifth instars were placed for a day with leaves or twigs of plants of 122 species, only *C. colococca* and *C. lockhartii* were attacked and in subsequent tests the larvae did not complete their development on either of these.

The adults are common on *Cordia* bushes during the wet season (May–December). The cuticle does not harden or assume its final colour for about two weeks after the beetles emerge, but they feed vigorously during this period. Males and females were found to consume averages of 0·52 and 0·7 sq. in. leaf per day during the first 40 and 30 days, respectively, of life ; subsequently, the averages fell to 0·26 and 0·4 sq. in. The basal part of the leaf was most frequently attacked, presumably owing to the weight of the beetle. Feeding became sporadic at the onset of the dry season, but was resumed at the beginning of the rainy season. Mating occurred about 16 days after emergence and subsequently at frequent intervals. In experiments, a single mating sufficed to fertilise all eggs laid during at least 32 days of active oviposition, and one female remained fertile without further pairing after dormancy. Unfertilised females did not oviposit. The eggs were deposited anywhere on the plant or in its immediate surroundings in masses of 11–78 covered with a glutinous secretion, and isolated pairs of beetles produced an average of 1,022·5 eggs over a period of 3–4 months of active oviposition. The adults survived for about four months during the wet season, and the males and females for averages of 141·6 and 156·9 days in the latter part of the wet season and during the dry season. The eggs hatched in about a week and the larvae fed on either surface of the leaves, each consuming an area of about 6 sq. ins. during its development. The larval, prepupal and pupal stages lasted about 17, 2 and 5 days, respectively. Breeding took place continuously throughout the wet season, and it is possible for five generations to be produced during this period, but there is considerable overlapping. Although food is plentiful at the beginning of the dry season, the adults ceased to feed and oviposit then and sheltered in the débris on the ground. This is not a true diapause, however, since they resumed activity if placed in a very humid atmosphere. Eggs and larvae were not observed during the dry season. Large numbers of mature adults were found feeding and mating on 29th May, four days after the rains had begun, and eggs were observed on 1st June.

Two parasites, *Horismenus* sp. [**37** 113] and *Syntomosphyrum* sp. were reared from the eggs. Total parasitism, most of which was due to *Horismenus*, fluctuated with season and locality, but was high except at the beginning of the wet season ; 97 per cent. of a collection of egg-masses made on 5th September 1946 were parasitised, and as all or most of the eggs in any parasitised mass are attacked, this figure is indicative of the degree of parasitism among the eggs. In general, only one parasite emerged from each egg, and each egg mass was attacked by only one parasite species. The development of both parasites required about 15 days. The larvae of *Physonota* were attacked by a species of *Bucelatoriopsis*, possibly undescribed ; percentage parasitism by this Tachinid averaged about 20, but sometimes reached 50. The eggs are probably laid on the young host larvae ; when fully grown, the Tachinid larva leaves the prepupa of the host and forms a puparium from which the adult emerges after about ten days. A few Chalcids of the genus *Brachymeria* were reared from pupae of *Physonota*. Predators attack the immature stages of the beetle to such an extent that its distribution is restricted to areas in which they do not occur. An attempt to establish it at various points at which it is not present by the liberation of adults and larvae in various stages was unsuccessful. Eggs were laid and hatched normally, but all the young larvae were removed by ants, which also destroyed the pupae. In experiments in which all stages of the Cassidid were released on *Cordia* in pots from which ants were excluded by means of adhesive bands or water barriers, the older larvae were removed by *Polistes canadensis*, L., and, to a less extent, by spiders. In the field, birds may also destroy larvae and egg masses. Ants present where *Physonota* occurred were *Camponotus zoc*, Forel, *C. sexguttatus*, F., *Pseudomyrma* sp., *P. gracilis*, F., var. *agilis*, F. Sm., *P. elegans*, F., *Paratrechina longicornis*, Latr., and *Ectatomma ruidum*, Roger. Some of these were also present at a place where an unsuccessful attempt at establishment was made, together with *Pseudomyrma flavidula*, F. Sm., *Brachymyrmex* sp., *Solenopsis* sp. and *S. geminata*, F., the last of which is thought to have been mainly responsible for the failure of the attempt.

MOUTIA (L. A.). **En marge de la lutte contre l'herbe Condé** : *Cordia macrostachya* **(Jacq.) Roem. and Schult. ; la fourmi rouge :** *Solenopsis geminata* **F. et le charançon de l'eucalyptus :** *Gonipterus scutellatus* **Gyll.**—*Rev. agric. Maurice* **26** no. 3 pp. 125–137, 1 fldg. table. [Port Louis] 1947.

More than 12,000 individuals of *Anaphoidea nitens*, Gir., the Mymarid egg parasite introduced into Mauritius against *Gonipterus scutellatus*, Gylh., on *Eucalyptus* [*R.A.E.*, A **36** 125, etc.], were reared in the laboratory between April 1946 and June 1947 and liberated in batches of 100–300 at 36 places throughout the island. The parasite was recovered at 22 places 3–4 months after the first release, and in some cases had spread 6–9 miles from the liberation point. It was found in all of 50 samples of egg capsules collected from all over the island, and 26 per cent. of all capsules were parasitised. It is likely to control its host because it can increase more rapidly, since its life-cycle lasts 13–16 days, so that it can complete 24 generations a year, and the females are three times as numerous as the males, whereas *Gonipterus* has only four generations a year and a sex ratio of 1 : 1.

Solenopsis geminata, F., is a troublesome pest in Mauritius, damaging vegetables and other plants, particularly in seed beds, but experiments have shown that benzene hexachloride diluted in fine air-dried soil to give a concentration of 0·2 per cent. γ isomer is very toxic to it. Seed beds can be protected by spreading the dust in a band, 2 ins. wide, round the edge, and the nests can be effectively treated by applying it to them at a rate of about 0·1 gm. γ isomer per sq. ft. The nest should be opened at nightfall, half the mixture forked into it, and the rest spread on top ; the ants are killed in a few minutes. If the nest is very deep and in communication with untreated ones, some ants may construct another nest, in which case a second treatment becomes necessary. The cost is rather less than half that of the treatment previously recommended [**33** 371].

During the first half of 1947, eight consignments of the Cassidid, *Physonota alutacea*, Boh., were received from Trinidad for test against *Cordia macrostachya* in Mauritius [*cf.* preceding abstract]. The beetles were sent by air in a light wooden box containing only packing straw and wrapped first in grease-proof paper as a guard against fluctuations in temperature and humidity and then in wrapping paper. The journeys lasted 19–22 days, but 218 of the 450 despatched arrived alive. In the insectary, the beetles fed, but not voraciously, on the leaves of *C. macrostachya* and the females oviposited nearly every other day for a month, the eggs being laid in groups of 30–60 on the lower sides of the leaves. Three females laid a total of 1,265 eggs in 51 groups in 36 days. The larvae hatched in 8–11 days and fed gregariously on the lower epidermis of the leaves, moulting after 4–5 days. The larval stage lasted 20–30 days, during which there were five moults, after the third of which the larvae skeletonised the leaves. The prepupal and pupal stages lasted 2–3 and 9–10 days. The adults survived for at least three months, during which they fed, mated and oviposited continuously. In food tests in which adults and first- and third-instar larvae were confined on nearly 90 plants, most of them of economic importance, none was attacked except *Cordia abyssinica* and *C. myxa*, on which normal development occurred.

WILLIAMS (J. R.). **The Introduction of** *Physonota alutacea* **Boheman (Col., Cassid.) into Mauritius.**—*Bull. ent. Res.* **40** pt. 4 pp. 479–480, 6 refs. London, 1950.

Following the introduction of *Physonota alutacea*, Boh., into Mauritius from Trinidad for test against *Cordia macrostachya* [see preceding abstract], 21,000 adults, 4,000 larvae and 280 egg-masses, comprising approximately 7,000 eggs, of this Cassidid were released in various localities between 11th June 1947 and 28th May 1948. Adults were frequently observed mating and ovipositing on the bushes several weeks after liberation, but although first-instar larvae were occasionally found, they invariably disappeared within 24 hours. In Trinidad, the distribution of *P. alutacea* is restricted, apparently by the activities of *Solenopsis geminata*, F. [*cf. R.A.E.*, A **38** 190], and since this ant is widespread in Mauritius, it was thought that it or other predators might be preventing the beetle from becoming established. When a *Cordia* bush was enclosed in mosquito netting to exclude predators such as *Polistes* and birds and surrounded with a ring of benzene hexachloride to exclude *S. geminata*, first-instar larvae of *P. alutacea* still disappeared overnight. The only other insect on the bush was *Technomyrmex detorquens*, Wlk., which is not predacious but against which benzene hexachloride is ineffective, and when it was excluded by means of an adhesive band, larvae of *P. alutacea* developed to the last instar. *Technomyrmex* later gained access to the bush by means of leaves growing against the netting, and the larvae again began to disappear. Since large numbers were found adhering to the lower edge of the band, it is concluded that the ants disturb them, causing them to fall to the ground, where they either die or attempt to regain the bush. An examination of *Cordia* bushes in 18 localities showed that seven species of ants occurred on them. *T. detorquens* was present in all but five localities, and was usually dominant. Where it was absent, it was replaced by *Pheidole megacephala*, F., which is predacious and may take some of the young larvae, but also feeds on plant juices, or *Tetramorium simillimum*, F. Sm. Of the remainder, *Camponotus grandidieri*, Forel, is believed to be predacious and the other three were not common on *Cordia*. Salticid spiders removed some of the young larvae of *P. alutacea*, and egg masses were sometimes damaged by an unknown predator, but *Technomyrmex detorquens* is believed to be the primary factor preventing the establishment of *P. alutacea*.

RIPPER (W. E.), GREENSLADE (R. M.) & HARTLEY (G. S.). **A new systemic Insecticide bis(bis Dimethylamino Phosphonous) Anhydride.**—*Bull. ent. Res.* **40** pt. 4 pp. 481–501, 2 pls., 8 graphs, 13 refs. London, 1950.

The results are given of investigations with bis[bis(dimethylamino)]phosphonous anhydride [*cf. R.A.E.*, A **37** 486, 487] to obtain information on its action as an insecticide, its effectiveness in the field and its toxicity to mammals. This compound is normally a dark brown liquid with a viscosity rather less than that of olive oil and a slight odour. A highly purified specimen was of pale straw colour and solidified on cooling, its melting point being 14–20°C. [57·2–68°F.]. The specific gravity of the pure anhydride is 1·09 25°/4°C. The compound is miscible in all proportions with water and most organic solvents, but is only slightly soluble in refined mineral oils and incompletely miscible with vegetable and crude mineral oils. Its volatility is low. When dry it is for all practical purposes indefinitely stable ; it is slowly hydrolysed in dilute solution in water. Alkali slightly increases the rate of hydrolysis, and hydrolysis is catalysed in a marked manner by acid.

The direct contact action of the compound is very weak against Aphids and negligible against other insects, and it has no fumigant effect ; residual films have no contact action. Its systemic action in plants is most marked against Aphids, but is also effective against other sucking insects and spider mites. In experiments with potted plants, Aphids on the upper parts of plants were killed when the roots were watered with a solution of the compound, application to the upper surfaces of the leaves killed Aphids and *Pseudococcus citri*, Risso, feeding on the lower surfaces, and spraying the lower leaves killed Aphids on the flowers, tips and remaining leaves, the compound travelling through the plant over distances varying from the thickness of a leaf to three feet. It has been found effective against 15 species of Aphids, two Jassids, an Aleurodid and two Tetranychid mites. The concentrations that gave 50 per cent. mortality of *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., on chrysanthemum, *Aphis fabae*, Scop., on beans, and *Pseudococcus citri* on chrysanthemum and on *Coleus* in 48 hours in laboratory tests were 0·0165, 0·031, 0·11 and 0·048 per cent., respectively ; in general, large species required higher dosages than small ones. In practice, the speed of action is proportional to the amount of insecticide applied to the plant, and a given amount has been found effective at great and small dilutions. The compound appears to be conveyed to areas of new growth in the same manner as food materials, and it is often much less effective on mature plants than on growing ones. The concentrations that can be safely applied to plants were found to vary considerably, 15 per cent. of a 30 per cent. formulation causing no injury to mangolds, while potatoes were injured by concentrations exceeding 0·3 per cent. In limited tests, the compound was compatible with HETP (hexaethyl tetraphosphate), wettable DDT, copper oxychloride and cuprous oxide.

Since the compound has no contact effect on predacious insects, and Coccinellids and Syrphid larvae that come in contact with or feed on Aphids that have been killed by it are not harmed, it can be used as a selective insecticide for the control of Aphids. In field tests in which the non-selective organic phosphorus insecticides, parathion, diethyl paranitrophenyl phosphate, and HETP, were also used, these gave high mortalities of Aphids, but infestation quickly built up again and even became larger than before owing to the destruction of parasites and predators by the insecticides. The plants treated with bis[bis(dimethylamino)] phosphonous anhydride remained free from infestation for about a month, since the natural enemies were able to control the survivors and other Aphids entering the area from untreated plants.

Field experiments were carried out in various parts of England with sprays prepared from an anhydrous formulation containing 66 per cent. bis[bis-(dimethylamino)] phosphonous anhydride and sufficient wetting agent to wet hop leaves. Two applications of this formulation at ¾ lb. per 100 gals., the first at 100 and the second at 150–200 gals. per acre, kept hops free from infestation by *Phorodon humuli*, Schr., and *Tetranychus telarius*, L., during the growing season, and two to strawberry at 1½ lb. in 100 gals. per acre gave complete protection against *Capitophorus fragariae*, Theo. Cabbage and brussels sprouts sprayed with 7 lb. in 100 gals. per acre, with additional wetting agent, remained almost free from *Brevicoryne brassicae*, L., for over five weeks during a severe outbreak in 1949, incipient colonies being controlled by *Aphidius brassicae*, Marsh., Syrphids and Cecidomyiids. One application at 1 lb. in 100 gals. gave satisfactory control of *Macrosiphum rosae*, L., on rose, and repeated applications on sugar-beet reduced populations of *Myzus persicae*, Sulz., and *Aphis fabae* and so retarded and reduced infection by virus yellows. In experiments in Southern Rhodesia, treatment at the rate of 7½ lb.

in 100 gals. per acre gave practical control of *M. persicae* on tobacco for three weeks.

In experiments on the toxicity to mammals, the lethal doses per kg. body weight were 18 mg. for rats and 22 mg. for guineapigs when ingested, 18 mg. for rats when injected subcutaneously, and 200 mg. for rats when an alcohol solution was rubbed on the shaved skin. The symptoms of poisoning are described, with the results of histological examination. The anhydride is less toxic than parathion, diethyl paranitrophenyl phosphate or HETP, but is nevertheless very toxic. Suggestions are given for the treatment of casualties, based on experiments with rats and dogs. Precautions include the use of protective cabs on tractors to prevent the spray drift from reaching the operator, and the wearing of overalls and rubber gloves by persons handling the concentrate to avoid skin contact.

In feeding trials with treated plant material, rabbits and guineapigs were fed repeatedly on shelled peas, strawberries, apples and hops from crops that had been sprayed during the growing season. The quantities were much larger than could be expected in human consumption of such food, and in no case were any toxic symptoms observed, nor did histological examination of the organs reveal any pathological phenomena.

A method of analysis of plant material, sensitive to the presence of 0·46 mg. of the compound, is described. Sugar beet and hops that had been sprayed during the summer were examined by this method at harvest, and no trace of the anhydride was found. The same applies to strawberries treated while budding and hops sprayed one week before harvest.

PHIPPS (J.). **The Maturation of the Ovaries and the Relation between Weight and Maturity in** *Locusta migratoria migratorioides* (**R. & F.**).—*Bull. ent. Res.* **40** pt. 4 pp. 539–557, 15 figs., 13 refs. London, 1950.

The following is virtually the author's summary. Investigations were made of the process of the maturation of the ovaries and of the relation between mating and sexual maturity and between sexual maturity and weight. The locusts used were of the *transiens* phase. They were kept at temperatures between 32 and 37°C. [89·6 and 98·6°F.] and relative humidities between 50 and 70 per cent. The maturation of the ovaries is divided into four stages, distinguished chiefly by the size of the eggs. The average number of ovarioles per female does not change significantly with age, but the numbers in the two ovaries often differ, and the difference probably increases with age. Some of the ovarioles are small, and the percentage of small ones increases with development of the eggs. Variation between individuals in the total number of ovarioles also increases with age. The number of egg rudiments per ovariole at different ages and stages did not differ significantly, and it is concluded that new rudiments are produced during the oviposition period.

When the food supply was relatively small, female locusts became mature and oviposited if allowed to pair, but not in the absence of males. With abundant food, unmated females matured, but more slowly than mated ones, and their fecundity was reduced. Average weights of female locusts in each of the four stages were compared. Mature locusts, in stages III and IV, were significantly heavier than locusts in stages I and II. The average weight of a number of stage I locusts 13–18 days old, the development of which had been retarded by unsuitable conditions, was less than that of a number of stage III locusts of the same age. It is concluded that weight depends primarily upon the development of the ovaries. The relation between weight and age was investigated. Rate of increase of weight is rapid at first, is reduced for about two days, then increases again and maintains its value until the weight is about 2 gm. During the oviposition period it fluctuates irregularly. If conditions are unfavourable to maturation, the weight rises to a certain value, after which it remains constant or falls. The fall was best seen in stage II locusts over 14 days old. There is little relation between weight and egg-size in stages I and II, but in stages III and IV the relation is closer. Rate of increase of weight with egg-size is at first low, but becomes greater above an egg-length of about 4·5 mm. It is suggested that this is because early growth of the eggs is due to transference of fat from the fat-body and later stages to the laying down in the eggs of substances derived directly from the food.

Estimates were made of the water and fat content of locusts of various ages. The water percentage falls rather rapidly in the first few days of adult life, after which it remains approximately constant. The fat percentage rises to a maximum at about 14 days and then falls slowly. Most of the increase in weight during maturation is due to water intake.

JAYNES (H. A.) & SPEERS (C. F.). **Biological and ecological Studies of the Spruce Budworm.**—*J. econ. Ent.* **42** no. 2 pp. 221–225, 1 ref. Menasha, Wis., 1949.

A preliminary report is given of studies carried out in northern New York in 1946 and 1947 to obtain information of use in developing forest practices that would reduce the injury caused by *Choristoneura* (*Archips*) *fumiferana*, Clem., to spruce and balsam fir [*Abies balsamea*]. The following is based on the authors' summary. Larvae that fed on trees having staminate flowers [*cf.* *R.A.E.*, A **35** 79] were slightly ahead in development of those that fed on trees not having flowers, but females from larvae that fed on pollen did not lay more eggs than those from larvae that fed on vegetative growth, and feeding on pollen-bearing flowers had no effect on the sex ratio. In 1947, when there was an abundant production of staminate flowers on balsam fir and spruce, the population was greatly reduced.

Feeding experiments in the laboratory in 1947 showed that larval survival was high on balsam fir and on red, black and white spruce [*Picea rubra*, *P. mariana* and *P. glauca*] if the larvae had access to foliage grown in 1946 and buds of 1947. It was high on balsam fir but low on spruce when only foliage of 1945 was present, and the larvae that survived on 1945 spruce foliage produced moths that were usually small and had a low egg potential. *P. glauca* was definitely preferred to *A. balsamea*, *P. rubra* and *P. mariana* for oviposition ; the characteristics of the foliage appeared to affect selection of a place for oviposition. The young larvae seeking places for hibernation showed little or no preference for staminate bracts, and most of them hibernated near the egg cluster if they found a suitable place. The percentage mortality of individuals that hatched in July 1946 was 20 by February 1947, 75–84 by late May, when the larvae were entering the needles, and more than 97 before the adult stage was reached. The percentage of overwintering larvae attacked by fungi was 5 in 1946–47 and 52 in 1947–48. The loss of larvae from the needle-mining period to the bud-feeding period was especially high on *P. mariana*.

Defoliation caused by *C. fumiferana*, recorded on 37 plots in 1945–47, showed an increase in six plots, no change in eight and a decrease in 23, many of the last being on the periphery of the budworm area, in 1946 and a marked decrease in all but two plots in 1947. Increment borings were taken on balsam fir in several plots, but the only indication of reduced growth was in trees subjected to heavy defoliation for two successive years followed by medium defoliation in the third year.

BROWER (A. E.). **The Beech Scale and Beech Bark Disease in Acadia National Park.**—*J. econ. Ent.* **42** no. 2 pp. 226–228. Menasha, Wis., 1949.

Cryptococcus fagi, Baer., spread rapidly on beech in Maine following its discovery there in 1931 and is now the most important insect pest of that tree in the north-eastern United States [*cf. R.A.E.*, A **33** 354]. Although it kills large proportions of the bark, it is said not to kill the trees by itself, but heavily infested trees are regularly attacked by the fungus, *Nectria coccinea* var. *faginata*, which does not otherwise become established, and the combination has killed or badly damaged many of the large beech trees attacked. Occasionally trees only five inches in diameter are killed, and even small shoots may be heavily infested by the scale. Many old trees survive infestation with only a few small trunk branches living, and an old stand in which 50 per cent. of the trees were still alive showed almost complete destruction of the canopy ; the remaining severely damaged trees would probably be destroyed in time by a heavy infestation of *Fomes fomentarius* that followed.

Since the beech trees in the National Park on Mount Desert Island are well isolated from the nearest beeches on the mainland it was hoped that they would not become infested. However, a few infested trees were found in 1934, and these were burnt and removed. In 1935 and 1936 more infested trees were found in two areas and removed, and in 1937 these areas were sprayed with lime-sulphur, but surveys made in January and February 1938 showed that the scale was present in the majority of the beech areas, and it has since spread to practically all beech trees on the island. Inspection of sprayed areas showed that thoroughly wetting the trunks with liquid lime-sulphur in water (5 : 95) or 20 lb. dry lime-sulphur per 100 U.S. gals. gave complete kill and prevented reinfestation during the season, and in the spring of 1938 all known accessible infestations were sprayed, but without complete control, owing to poor coverage. In 1939, a few areas of beech were selected for preservation and sprayed, and it was found that with thorough coverage, the interval between treatments could be 4–5 years, depending on the proximity of unsprayed infested beech. No parasites of the scale were found, but *Chilocoris stigma*, Say, appeared to give important control of small infestations. *Nectria* was first found on the island in 1943. It became impossible to eradicate, but its development is evidently dependent on injuries or an abnormal physiological condition produced in the bark by the scale, and it was checked by spraying the trees while the scale infestation was still of medium intensity (2,000–3,000 crawlers per square inch of most heavily infested bark). It was found that surviving trees developed a resistance to attack, apparently in the bark, and first the scale and later the fungus subsided on them to much lower levels.

PIMENTEL (D.). **Biology of** *Gnathocerus cornutus*.—*J. econ. Ent.* **42** no. 2 pp. 229–231, 6 refs. Menasha, Wis., 1949.

Gnathocerus cornutus, F., is widely distributed in the United States and injurious to cereal and animal products. Much of the information available on its biology is conflicting, and tests were therefore carried out on its development in different environments. The food used was meat-bone meal with Haydak's mixture [*R.A.E.*, A **25** 187]. The most favourable temperatures and humidities were 15–32°C. [59–89·6°F.] and nearly zero to 12·7 mm. saturation deficit, the optimum being near 24–30°C. [75·2–86°F.] and 2·5–7·5 mm. deficit. Exposure to various combinations of temperature and humidity showed that at favourable humidities, temperatures slightly above 32°C. or below 15°C. killed the adults in a few days, before they could reproduce. High saturation deficits were most injurious at high temperatures.

An indication of the number of eggs laid was obtained by counting the larvae produced by individual females. The greatest number was about 360 in a period of five months ; the adults lived for about eight months under optimum conditions. The egg stage lasted 5–8 days at 20–30°C. [68–86°F.] if humidity was favourable, but the larvae had difficulty in emerging from the eggs at high saturation deficits. The larvae developed well in most environments in which hatching occurred, except at saturation deficits of 0·9 and 1 mm. and temperatures of 27°C. [80·6°F.] and 30°C., respectively. At low saturation deficits, the food became infected with fungi, and these may have killed the larvae. The larval period was about five times as long at 15°C. as at 32° C. at a saturation deficit of 4–5 mm., and a high saturation deficit lengthened the larval period slightly. The proportion of larvae surviving was very high, which shows a wide tolerance to temperature and moisture, particularly the latter.

Under optimum conditions, individual larvae given 0·025 gm. food each required 25 days for larval development, and those supplied with 0·018 gm. with added food in the fifth instar required 30 days for the larval stage and 8 days for the pupal stage. Larvae kept in groups required 39 and 10 days, respectively, and wherever larvae were crowded the periods were greatly lengthened. The insects were very sensitive to lack of moisture in the prepupal and pupal stages (considered together), and the percentage survival decreased sharply above 8 mm. saturation deficit, with no survival at 19 mm. Temperatures between 20 and 32°C. had no apparent effect. Prothetely was observed in four different environments.

MEDLER (J. T.) & CHAMBERLIN (T. R.). **Low Pressure Spraying Equipment for Control of some Forage Insects.**—*J. econ. Ent.* **42** no. 2 pp. 239–243, 3 refs. Menasha, Wis., 1949.

Since many farmers now possess low-pressure sprayers for the application of herbicides, experiments were made on forage crops in Wisconsin in 1948 to ascertain whether they would also be suitable for use with insecticides, in place of expensive high-pressure equipment. Applications to field plots were made as uniformly as possible with a sprayer mounted on a truck having a 20-foot boom, adjustable in height from 2 to 3 ft. and carrying 13 nozzles 20 ins. apart mounted on the front bumper. Fan-type nozzles with an orifice of 0·039 inch and 80 mesh screen were used, and agitation was supplied by a by-pass from the pump. Amounts of insecticide are those used per acre.

On 10th and 11th June, a centrifugal-jet pump was used to apply sprays at a pressure of 30–40 lb. and a rate of about 15 U.S. gals. per acre to a heavy stand of knee-high lucerne grown for seed. The average numbers of nymphs of *Adelphocoris lineolatus*, Goeze, per sweep of the net on 17th and 29th June and of adults on 29th June were 0, 0 and 1 for 1 lb. technical chlordan, in a 50 per cent. wettable powder, 0, 0 and 2 for 1 lb. chlordan in a 50 per cent. emulsion concentrate, 0·25, 0 and 2 for 1½ lb. technical chlorinated camphene [toxaphene] in a 40 per cent. wettable powder, 0, 0 and 3·5 for 3 lb. toxaphene in a 50 per cent. emulsion concentrate, and 22·8, 16·2 and 11·2 for no treatment. It was evident from other experiments that good control would also be obtained with 1½ lb. toxaphene in emulsion per acre. The treated lucerne produced about five times as much seed as the untreated. A rotary gear pump was also used on 11th June to apply the same sprays at 40 lb. pressure and about 30 U.S. gals. per acre to lucerne in another district. The average numbers of adults per sweep on 28th June were 1·5 and 4 for 2 lb. chlordan in wettable powder and emulsion, respectively, 2 and 7·5 for 2 and 6 lb. toxaphene in wettable powder and emulsion, respectively, and 8·5 for no treatment ; there were no nymphs on treated plots and 4·7 per sweep on untreated ones. The emulsions had evidently not retained their effectiveness against the adults, though the large number in the toxaphene plot may have been due to recent migration from untreated areas.

In experiments on second-growth lucerne, sprays were applied with the gear pump on 3rd August at 30–35 lb. pressure and 20 U.S. gals. per acre. The numbers of adult Mirids (including *A. lineolatus*, *A. rapidus*, Say, and *Lygus oblineatus*, Say) and of grasshoppers in 16 sweeps on 12th August were 4 and

31 for 1 lb. technical DDT in a 25 per cent. emulsion concentrate, 8 and 3 for 1 lb. of a mixture of DDT and chlordan in an emulsion concentrate containing 20 per cent. DDT and 45 per cent. chlordan, 6 and 0 for 1 lb. chlordan in a 36 per cent. emulsion concentrate, 7 and 12 for 1·5 lb. toxaphene in a 43·5 per cent. emulsion concentrate, 3 and 21 for 1 lb. DDT as a 50 per cent. wettable powder, 7 and 2 for 1 lb. chlordan in a 50 per cent. wettable powder, 7 and 1 for 1·5 lb. toxaphene in a 40 per cent. wettable powder and 13 and 33 for no treatment ; there were seven Mirid nymphs on the untreated plot and one each on the plots treated with chlordan emulsion and toxaphene wettable powder. Counts on 26th August indicated that DDT was still giving control of the Mirids, while chlordan and toxaphene were not, though they were still effective against the grasshoppers. In general, wettable powders maintained their effectiveness better than emulsions.

It is concluded from these tests and others in 1947 and 1948 that forage insects can be controlled with low-pressure spraying equipment. The most satisfactory boom appears to be 20–30 ft. long, and the most satisfactory nozzle a one-piece flat fan-spray type, of 60–85° spray angle, with a strainer, especially when wettable powders are being used. Any type of pump is apparently satisfactory provided that pressure and delivery are adequate. Agitation of the spray in the tank by a by-pass from the pump, which is usual, is seldom sufficient for wettable powders, since most of the pump capacity is required to supply the boom, so that emulsion sprays are more satisfactorily applied. The clogging of nozzles can be reduced by a line filter between the tank and pump. Satisfactory control was obtained with 1 lb. technical DDT or chlordan or 1·5 lb. toxaphene, pressures of 30–150 lb., vehicle speeds of 3–8 miles per hour, and nozzle orifices of 0·022–0·058 inch ; rates of application varied from 15 to 100 U.S. gals. spray per acre.

WOODRUFF (N.) & TURNER (N.). **Effect of Dispersing and Spreading Agents on Toxicity of DDT Spray Powders.**—*J. econ. Ent.* **42** no. 2 pp. 243–248, 4 figs., 14 refs. Menasha, Wis., 1949.

It was reported in 1944 that the addition of wetting agents to DDT sprays did not improve and in many cases reduced their toxicity to insects [*cf.* also *R.A.E.*, A **38** 178], but as their use offers many advantages, a further study of the question was made in Connecticut. The main factors thought likely to be involved are a reduction in coverage and excessive thinness of the film produced, and tests by the authors in 1948 showed that a given amount of DDT was more toxic to house-flies [*Musca domestica*, L.] when applied to part of a surface than when spread over the whole of it. Reduction in tenacity is another possible factor [*cf.* **25** 495].

In the experiments described in this paper, the sprays were suspensions of powders containing 50 per cent. DDT with diatomaceous earth or clay as the diluent, and two dispersing agents, chosen because they do not lower the surface tension of the water and therefore should not affect droplet size, were used as well as two wetting agents. The wetting agents were Tritox X-100 (polyethylene glycol phenylisooctyl ether) and Igepon-T-Powder (a sodium salt of sulphonated ethylmethyl oleylamide), and the dispersing agents were Darvan 1 and Darvan 2 (polymerised sodium salts of alkylaryl sulphonic acids). In the laboratory, the sprays were applied to glass slides, and the deposits were tested for toxicity to house-flies. The addition of 0·25–2 per cent. of Igepon-T-Powder or either dispersing agent to a suspension containing 0·0625 per cent. DDT reduced its toxicity progressively as the amount of additive increased, but the toxicity of sprays containing 0·125–0·0156 per cent. DDT was not appreciably affected by the inclusion of much smaller amounts of Triton X–100 or either dispersing agent (equivalent to 2 per cent. of the DDT or 1 per cent. of the spray powder) either when they were mixed with the powder or added after the latter was in suspension.

In tests of the effect of the dispersing agents on tenacity, in all of which the sprays contained 0·5 per cent. DDT, glass slides that had been weighed, sprayed, dried and re-weighed for actual deposit were washed in cold water and weighed again. In the first series of tests, the dispersing agents were added to the sprays at concentrations of 0·5–2 per cent. Unlike wetting agents [*cf.* **38** 180], the dispersing agents increased the deposit as the concentration was increased, though they reduced tenacity greatly. However, mortality of flies exposed to the smallest of the final deposits was high, indicating that these must be substantially pure DDT, the dispersing agent and diluent (diatomaceous earth) washing off independently. When 1 per cent. dispersing agent was added to the spray powder (DDT and clay), the deposits were not affected, and although tenacity was slightly reduced, this would be offset by the high toxicity of the residue.

In field tests, 1 per cent. Darvan 2, 1 per cent. Triton X-100 or a mixture of the two was added to the DDT-clay powder, which was applied to potatoes infested with potato flea-beetles [*Epitrix cucumeris*, Harr.] in sprays containing 1–0·125 lb. DDT per 100 U.S. gals. weekly from 8th June to 26th July. The results confirmed the laboratory finding that the addition of small amounts of either dispersing or wetting agent does not affect the toxicity of the DDT mixture ; even when both were added, there was no loss in either control or yield.

WOODRUFF (N.) & TURNER (N.). **Concentrated DDT Spray Powders.**—*J. econ. Ent.* **42** no. 2 pp. 249–253, 4 figs., 11 refs. Menasha, Wis., 1949.

The following is based on the authors' summary. Three types of concentrated DDT water-dispersible powders, one consisting of 83·5 per cent. DDT with approximately equal quantities of talc and a complex colloidal magnesium aluminium silicate and the others of 90 per cent. DDT with one or other of two silica aerogels (differing in particle sizes and density), were compared with standard 50 per cent. powders. In the laboratory, deposits from sprays containing the concentrates showed greater toxicity to house-flies [*Musca domestica*, L.] than those from sprays containing 50 per cent. powders applied at the same dosage of DDT. The silicate and the silica aerogels were much more tenacious than diatomaceous earth, which was selected as a representative of diluents used in 50 per cent. powders, and the concentrated DDT powders showed much greater toxicity after washing of the deposit from 0·5 per cent. suspensions than two standard 50 per cent. DDT mixtures in clay and diatomaceous earth. In field tests on potato in Connecticut, the mixture containing the colloidal silicate gave significantly better control of both over-wintering and summer generations of flea-beetles [*Epitrix cucumeris*, Harr.] than the two standard powders when applied eight times between 11th June and 30th July, but the more toxic of the mixtures containing silica aerogel was only equal to the standard powders, possibly owing to poor suspension in the spray tank.

ECKERT (J. E.). **Determining Toxicity of Agricultural Chemicals to Honey Bees.**—*J. econ. Ent.* **42** no. 2 pp. 261–265, 1 fig. Menasha, Wis., 1949.

Since honey bees are the main insect pollinators of crops in the United States and are increasing in importance because of the decrease in solitary bees through the effects of poisoning, weed control and intense cultivation, their welfare should be considered in all pest-control programmes. The author shows that the results of laboratory experiments on toxicity to bees have been expressed in such a variety of ways that they cannot be compared and that field results are subject to still greater variations because the flight of the insects cannot be controlled. He discusses the relative value of laboratory and field observations and concludes that laboratory results may not indicate more than the need for extreme care in the use of certain chemicals on plants in bloom or when pollinators are most active, the amounts that may prove injurious on plants that are visited by bees, and the greater safety of one chemical over another.

The results are given of laboratory tests in which chlordan, dissolved in acetone, and other insecticides in alcohol were added to 20 per cent. sugar syrup, various amounts being then supplied in inverted vials to groups of bees or fed to individual bees with a micropipette, and of others in which the bees were subjected to contact and fumigating actions. In the feeding tests, some bees were kept at 70–85°F., and others at 95°F. with a high humidity, but only the toxicity of DDT was apparently affected, the median lethal dose in 72 hours being 4·6 mmg. per bee at 70–85°F. and 12 at 95°F. and the intervals before death 1–48 and 5–120 hours, respectively. The median lethal doses for 90 per cent. γ BHC (benzene hexachloride), chlordan, compound 118 [1, 2, 3, 4, 10, 10-hexachlor-1 : 4, 5 : 8-diendomethano-1, 4, 4a, 5, 8, 8a -hexahydronaphthalene] and DDD (dichlordiphenyldichlorethane) were 0·15, 1·21, 0·25 and 16 mmg. per bee and the times before death 3–24, 5–24, 6–144 and 2–72 hours, respectively, and those for HETP (hexaethyl tetraphosphate), parathion, TEPP (tetraethyl pyrophosphate) and toxaphene 0·29, 0·07, 0·75 and 22 mmg. and 2–24, 1–24, 1–24 and 5–24 hours, respectively. The times before death after contact action were 0·1–0·5, 0·1–0·5, 1–2, 2 and more than 5 hours for BHC, chlordan, compound 118, DDD and DDT and 1–48, 0·5, 0·5 and 1–3 for HETP, parathion, TEPP and toxaphene, and those for the fumigant action were 0·5–1·5 hours for BHC, 1·5 for chlordan, 4 for compound 118 and 3–6 for parathion ; DDT, DDD and toxaphene had no fumigant action, and the other materials were not tested. Whatever the method of poisoning, the bees became abnormal in much less time and would in most cases have died earlier without the protection of the cages.

Under field conditions, DDD caused no appreciable injury to the population of colonies, and DDT was injurious to the field force only when used on lucerne in full bloom ; in no case did DDT cause the loss of an entire colony. Chlordan dusts sometimes reduced the field force of colonies by 50–80 per cent. when applied to lucerne in bloom. Chlordan in oil (2·5 per cent. solution) caused the loss of brood and some of the bees when applied in hot weather to grass in front of the hives, but quick removal of the affected colonies prevented much heavier losses ; the bees apparently circulated the fumes through the hives by their ventilating operations. Toxaphene, DDD and DDT appear to be relatively safe when used at 1·5 lb. per acre, especially if applied when the bees are not flying and the plants not in bloom. The destructiveness to bees of the other chemicals tested may depend on the concentration used and the time of application. None of them repelled bees in suspensions or solutions, and none had sufficient repellency to prevent the loss of bees when applied as a dust.

WOLCOTT (G. N.). **The most effective Termite Repellents.**—*J. econ. Ent.* **42** no. 2 pp. 273–275, 1 ref. Menasha, Wis., 1949.

The author gives a table showing the periods for which samples of susceptible wood immersed for ten minutes in solutions of various chemicals have so far been exposed to *Kalotermes* (*Cryptotermes*) *brevis*, Wlk., without being attacked in experiments in progress in Porto Rico [*cf. R.A.E.*, A **36** 232]. They are 4–5 years for copper pentachlorphenate (0·1 per cent. solution), ferric dimethyldithiocarbamate (0·5 per cent.), hexachlorphenol and pentabromophenol (1 per cent.), DDT and pentachlorphenol (2 per cent.) and chlorinated anarcardic acid and tetrachlorphenol (5 per cent.) ; 3–4 years for sodium pentachlorphenate (0·2 per cent.), α-naphthoflavone, xanthone, pyridyl mercuric chloride and pyridyl mercuric stearate (0·5 per cent.), diphenyl mercury, phenyl mercuric chloride and β-methyl anthraquinone (tectoquinone) (1 per cent.), triphenyl stibine and triphenyl phosphite (2 per cent.) and chlorinated crude cardol (5 per cent.) ; two years or more for copper dimethyldithiocarbamate, zinc dimethyldithiocarbamate and zinc lake (acetic acid) chrysazin (0·5 per cent.) and zinc lake (acetic acid) quinizarin and zinc lake (acetic acid) β-chloranthraquinone (1 per cent.) ; and 1–2 years for Genicide acids (a by-product of the manufacture of xanthone), 4,6-dinitro-o-sec.-butyl phenol and piperonyl cyclonene (piperonyl cyclohexenone) (1 per cent.) and diphenyl selenium, 2,4-dichlorphenyl potassium monochloracetaldehyde disulphonate and 1,1-diphenyl(4-hydroxy-3,5-dichlor)-2,2,2-trichlorethane (2 per cent.).

The results indicated that susceptible wood dipped in 2 per cent. DDT or pentachlorphenol would not be attacked within the period of anticipated service and could be considered to be permanently protected against termite attack. No other chemicals have been tested for so long, but several have been effective for almost as long at greater dilutions and would appear to be even more effective. For actual treatments, it is suggested that at least twice as great a concentration should be used to provide an ample margin of safety, and the necessity of covering every exposed surface of the wood is stressed.

Sodium pentachlorphenate, which is cheap and plentiful, gave better results than compounds of any other toxic metal but copper ; it is water-soluble and therefore subject to leaching, but this is of little importance in the environment of dry-wood termites. Copper pentachlorphenate is dissolved in alcohol and diluted with water for application to wood and does not affect its appearance. Ferric dimethyldithiocarbamate, which is soluble in acetone, stains light-coloured wood dark grey. The zinc and copper salts are also soluble in acetone, should be more effective than the ferric salt and do not stain the wood. Tectoquinone is an extractive of teak (*Tectona grandis*) and may be the factor responsible for the resistance of that wood to decay and insect attack [**35** 375]. Crude cardol and anacardic acid are extractives of the husk of cashew nuts (*Anacardium occidentale*) and are very toxic to man as well as insects. They and their chlorinated compounds stain impregnated wood deeply and impart a permanent and characteristic odour to it. Xanthone, which is soluble in acetone, is twice as effective as tectoquinone but costs ten times as much. Tetrachlorxanthone, which is initially more repellent than xanthone, did not protect the wood for two years at 1–2 per cent., and dichlorxanthone and dibromoxanthone are of only temporary value. The methyl and benzol compounds of xanthone have been tested for too short a time to confirm their preliminary promise.

The acetic acid lakes combining zinc with quinone dyes stained the wood samples superficially. The 4,6-dinitro-o-sec.-butyl phenol is a powerful yellow dye, which may not eventually prove to be the most permanently effective of the dinitro compounds for wood impregnation. The decreasing amounts of tetrachlorphenol, pentachlorphenol and hexachlorphenol needed to prevent termite attack illustrated the effect of the progressive chlorination of phenol, and the greater effectiveness of bromination than of chlorination was quite obvious. If diphenyls and triphenyls of ferric iron, lead, zinc and copper are ever synthesised they may prove to be more effective in protecting wood from dry-wood termites than any of the chemicals now available.

It is pointed out that chemicals that lose their toxicity after a time may yet be of value in protecting wood from insects that attack it only before it is seasoned.

BEARD (R. L.). **Species-Specificity of Toxicants as related to Route of Administration.**—*J. econ. Ent.* **42** no. 2 pp. 292–300, 1 fig., 8 refs. Menasha, Wis., 1949.

The author describes experiments in which four insects were treated with five insecticides, representing different types of action, by four different methods of application. The insects were honey bees, adults of *Oncopeltus fasciatus*, Dall., and larvae of *Popillia japonica*, Newm., and *Galleria mellonella*, L.; the insecticides were nicotine (free base), arsenic (sodium metarsenite), DDT, parathion and ethylene dichloride; and the methods of administration were by parenteral, enteral and topical application and by inhalation. All tests were made at 76°F., and the insects were anaesthetised with carbon dioxide before injection; 4–7 concentrations were used on 10–20 individuals each in each test, and each test was repeated 3–9 times.

The results are given in tables and discussed with reference to the relative susceptibility of the insects to the toxicants and the methods of application and the comparative toxicity of the various poisons. It is concluded that the species specificity of toxicants is definite and only partly overcome by changing the method of administration. When the most effective route of administration was used, the insects differed in order of susceptibility to all the insecticides. This is important when the possible usefulness of promising insecticides is to be investigated. Although the order of effectiveness of the methods of administration differed for the different insects, parenteral injection was generally the best. This supports the recent trend towards using this technique in programmes comparing new compounds as possible insecticides [*cf. R.A.E.*, A **37** 459], but there were sufficient exceptions to suggest caution in interpreting results based solely on it.

STEINHAUS (E. A.) & THOMPSON (C. G.). **Preliminary Field Tests using a Polyhedrosis Virus to control the Alfalfa Caterpillar.**—*J. econ. Ent.* **42** no. 2 pp. 301–305, 4 figs., 3 refs. Menasha, Wis., 1949.

In the course of studies on the aetiology and epizootiology of the polyhedral virus disease of *Colias eurytheme*, Boisd., which is an important factor in the natural reduction of populations of this Pierid on lucerne in California [*cf. R.A.E.*, A **38** 54, etc.], preliminary experiments were carried out in the summer of 1948 on the possibility of initiating the epizootic earlier than it begins in nature [*cf.* **33** 81]. Larvae were collected in the field and kept crowded together with previously infected individuals in rearing trays for a few days, after which nearly all were dead or dying from the disease. The infected bodies were collected periodically and kept in a refrigerator until needed. Infectious material for field distribution was prepared by triturating the larvae, which for the most part had disintegrated and were in a semi-fluid condition, to a thick homogeneous suspension, diluting this with distilled water (1 : 3) and passing through cheesecloth to remove large particles; the approximate number of polyhedral bodies was ascertained by counting with a haemacytometer. The concentrated material was diluted in the field to form a spray with a polyhedral count of 50–100 million per ml. and applied uniformly to four separate plots of lucerne in central California. Infection was established in each case, and the results showed that the disease markedly reduced the populations of *C. eurytheme* in the plots; that it is possible to initiate an epizootic in populations of low density (20–30 larvae per 10 sweeps of the net) and that even these low populations can be substantially reduced by the artificial dissemination of the virus ; and that it is possible to initiate an epizootic in a population of caterpillars earlier than it would occur naturally and so curtail the amount of damage done to the crop.

HAWKINS (J. H.) & THURSTON (R.). **Some Phases of European Corn Borer Control in central Maine.**—*J. econ. Ent.* **42** no. 2 pp. 306–311, 3 figs., 9 refs. Menasha, Wis., 1949.

In central Maine, the winter, often beginning in November with low temperatures and snowfall, lasts about four months, the spring is usually cool with ample rainfall, summer temperatures are seldom above 90°F., the growing season for maize is about 110 days, and the single-generation strain of *Pyrausta nubilalis*, Hb., predominates. Winter survival of the larvae is high (96 per cent. in 1947–48), probably partly because they overwinter in diapause and so can resist very low temperatures, and partly because snow protects them from extreme cold. In experimental plots, about 36 per cent. of the eggs failed to hatch in 1948, owing to lack of viability, detachment from the plants and attack by *Trichogramma minutum*, Ril., and a predacious mite. Only 27 per cent. of the larvae became established in untreated plots ; the weather between 27th July and 17th August was relatively dry with a few dashing showers, light winds and absolute and average minimum temperatures of 40 and 58·8°F., respectively, and conditions were unfavourable to larval establishment. Heavy mortality of the eggs and early larval instars has not prevented *P. nubilalis* from increasing in central Maine, however, and the cultural practices now in use are not sufficient to protect the maize crop from serious damage. The annual ploughing under of the stalks by 1st November is ineffective because the stalks are not sufficiently well covered or may be exposed by harrowing in spring, and the timing of planting to avoid heavy infestation would be of little value, since the maize would have to be planted before most ground is ready or too late to mature in most seasons.

Insecticide treatments were therefore tested in 1946–48. Four applications of dusts containing 1 per cent. rotenone, 3 per cent. DDT with 0·75 per cent. rotenone in sulphur, 3 per cent. DDT in talc and 3 per cent. DDT in sulphur gave 75·6, 76·1, 74·6 and 79·8 per cent. control in single tests, and four of 40 per cent. *Ryania* or 5 per cent. DDT in talc gave 73·1–92·7 and 75·9–92·9 per cent. in the three years. In 1948, four applications of sprays of DDT or *Ryania* gave slightly more control than the comparable dusts. Dusts containing chlorinated camphene [toxaphene] and benzene hexachloride were somewhat less effective than *Ryania* and DDT applied in the same manner and in comparable amounts, but dusts containing 5 per cent. DDD (dichlordiphenyldichlorethane), 2 per cent. parathion and 5 per cent. DDT in sulphur gave 93·5, 87·8 and 96·3 per cent. control. Although the amounts of insecticide used were excessive, the treatments would be profitable where prices for sweet maize were high.

It was apparent that insecticides were less effective against *P. nubilalis* in Maine than in other areas, but attempts to improve the results by combining materials were not entirely successful, though there was some indication that sulphur increased the toxicity of DDT. *Ryania* and DDT were considered promising, *Ryania* because it is said to be relatively safe to use on plants that are to be fed to livestock, and DDT where residues are not a problem. Maize plants from field plots that had been treated with DDT usually showed slight residues.

In 1946, heavy rain after the first and fourth applications of *Ryania* reduced control considerably. Rainfall also sometimes delays the application of insecticides, and it is possible that continued rain and high winds might affect the timing of insecticide applications. Data obtained in 1948 showed that single applications of 40 per cent. *Ryania* dust on 31st July or 6th August, which would be effective at the peak of egg hatching and when maximum numbers of first-instar larvae were present, respectively, gave as much as 40 per cent. control, as compared with 78·8 per cent. for four applications of the same material. An average increase of only 4·3 per cent. control was obtained by the addition of a fourth application of the *Ryania* dust in the three years, apparently because the first three were most effective when most of the larvae were hatching and only a small proportion of susceptible first-instar larvae were present when the fourth application was made.

The use of moth-emergence, oviposition and hatching dates to determine the timing of insecticidal applications is discussed, and the rise in moth emergence at the height of the season is suggested as a warning that there will be corresponding increases in oviposition and hatching within about 5–6 and 11–12 days, respectively, and so for predicting when treatments will be most effective.

GYRISCO (G. G.), NEWSOM (L. D.), MARSHALL (D. S.) & SCHWARDT (H. H.). **New Advances in Alfalfa Snout Beetle Control.**—*J. econ. Ent.* **42** no. 2 pp. 311–314. Menasha, Wis., 1949.

In field tests in New York in the spring of 1947, pyrophyllite dusts containing 5 per cent. DDT, chlordan and BHC (benzene hexachloride) (0·3 per cent. γ isomer), applied at 50 lb. per acre, gave 72, 95 and 83–96 per cent. reduction of *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L., on lucerne, and the standard bait of 85 lb. groundnut shells, 20 lb. sugar, 18 lb. soy-bean flour, 8 lb. sodium fluosilicate, 1 U.S. pint formalin and 12 U.S. gals. water gave 71 per cent. Owing to differences in infestation and plant stand in the different plots, there were no significant differences between treatments. In cage tests, on transplanted sod of mixed clover and lucerne, in which weevils were introduced on 11th–16th May, the same dusts applied on 11th May caused 98, 100 and 82 per cent. reduction in population by 24th May, as compared with 83 per cent. for the bait and 11 for no treatment. All treatments were significantly better than none, and there were no significant differences between them as measured by reduction in population of living beetles, but counts of larvae and infested plants in October showed that chlordan and BHC were significantly better than other materials in preventing the development of a new generation. Moreover, examination of surviving weevils showed that eggs developed in 36, 0 and 33 per cent. of those in dusted plots, in 98 per cent. of those in the baited plots and in 93 per cent. of those in untreated plots, and further examinations at a later date confirmed that sublethal doses of DDT, BHC and chlordan suppressed the formation of eggs in *O. ligustici.*

In 1948, 1 per cent. DDT, chlordan and γ BHC in impregnated dusts, applied by hand at 50 lb. per acre to a freshly ploughed lucerne field on 28th April, gave 42, 58 and 85 per cent. reduction in infestation in 144 hours ; 0·5 per cent. piperonyl cyclonene with 0·05 per cent. pyrethrins and 0·25 per cent. rotenone, or with 0·125 per cent. rotenone only, gave 25 and 30 per cent. ; and 5 per cent. DDT and DDD, 1 per cent. parathion and 10 per cent. chlorinated camphene [toxaphene] gave 27, 35, 91 and 76 per cent. The bait, applied at about 3 bushels per acre, gave 82 per cent. reduction. BHC and parathion were the most promising, toxaphene was promising though slow in action, and chlordan was ineffective at the low concentration used. The bait gave good commercial control. Dusts containing 1 per cent. parathion or γ BHC, 5 per cent. DDT or chlordan and 10 per cent. toxaphene were applied by helicopter on 29th April to single three-acre blocks of freshly ploughed infested lucerne ground at about 50 lb. per acre. All but DDT gave complete control in 12 days, but reinfestation occurred about five days later, indicating that at least two applications are needed, one just before the peak of emergence and one just at the peak. On 4th May, a biplane was used to dust three adjoining lucerne fields with 5 per cent. DDT and chlordan and 3 per cent. γ BHC, in pyrophyllite, at 50 lb. per acre. They reduced infestation by 0, 40 and 9 per cent. in three days and by 14, 90 and 0 per cent. in 11 days, and the percentages of new root infestations in the autumn were 20, 10 and 60, as compared with 40 in fields treated with the bait. The reason for the poor results given by BHC in this test is unknown.

MARSHALL (D. S.), NEWSOM (L. D.), GYRISCO (G. G.) & SCHWARDT (H. H.). **Control of the Clover Root Borer.**—*J. econ. Ent.* **42** no. 2 pp. 315–318. Menasha, Wis., 1949.

Nine years' investigations on red clover [*Trifolium pratense*] in New York showed that about 40 per cent. of the roots were infested by *Hylastes* (*Hylastinus*) *obscurus*, Marsh., in the first crop or first cutting year, with an average of 1·5 borers per plant, and nearly 100 per cent. in the second crop year, with 3·8 borers per plant. In 1946–48, control experiments were made on clover in the first crop year. Since the most vulnerable part of the life-cycle of the beetle is the short period in spring during which the adults migrate above ground [*cf. R.A.E.*, A **32** 5, 424], adhesive traps were set up round clover fields to determine when peak migration was to be expected and applications were timed accordingly. Three applications were made in 1946, the second being at about the peak of flight. In one test, in which the dates were 15th, 23rd and 30th May a BHC (benzene-hexachloride) spray containing 0·13 per cent. γ isomer, a BHC dust (0·66 per cent. γ isomer) and a 5 per cent. DDT dust, applied at 0·6, 0·33 and 2·5 lb. toxicant per acre, respectively, reduced the numbers of plants infested per sample of 60 taken in autumn from 51 for no treatment to 0, 1 and 13. In another test, in which the applications were on 10th, 15th and 30th May, the numbers of infested plants per sample of 80 were 61 for no treatment, 1, 8 and 18 for the BHC spray and dust and the DDT dust at the same rates as before and 7 for equal parts of the BHC and DDT dusts. Neither BHC nor DDT damaged the plants, and both gave excellent initial control of Aphids, which, however, became more numerous on many treated plots than on the controls within two weeks of the last application.

In 1947, when the effects of one or two applications of dusts at 50 lb. per acre were compared, dusts containing 0·63 per cent. γ BHC, 5 per cent. chlordan or 5 per cent. DDT, applied on 19th and 27th May, reduced the number of plants infested with *Hylastes* per sample of 80 from 43 to 0, 0 and 6, respectively, and dusts containing 0·63 per cent. γ BHC, 5 per cent. chlordan, or 0·32 per cent. γ BHC with 2·5 per cent. DDT, applied on 27th May, reduced it from 54 to 2, 13 and 17. All dusts gave highly significant control and caused a striking increase in the number of blooms and the fullness of the heads of the clover plants, and none injured the plants. There was a marked decrease in the amount of leaf-spot disease.

Since there were no significant differences in control of *Hylastes* between one and two applications in 1947, only one was made in 1948, at the peak of migration ; samples of 30 plants were examined. In one test, impregnated dusts containing 1 per cent. γ BHC, parathion, chlordan or DDT, applied on 27th May, at the height of migration, at the rate of 2·25 lb. toxicant per acre (2·25 lb. γ isomer in the case of BHC) reduced the number of infested plants per sample from 8 to 0, 1, 2 and 5, and left residues of 1·3, 0, 0·5 and 0·4 parts per million at harvest, and in another, the same dusts applied at 1·5 lb. toxicant per acre showed the same order of effectiveness. In an experiment with sprays containing wettable BHC, chlordan, DDT or parathion, applied on

1st June at 1 lb. toxicant per acre (γ isomer in the case of BHC), none gave significant control, possibly owing to the low rate of application and inferior coverage and penetration of the crowns of the plants ; the residues at harvest were zero for BHC, chlordan and parathion but 2·3 p.p.m. for DDT.

Since residues potentially hazardous to livestock and pollinating insects are important limiting factors in the use of insecticides on forage crops, only the minimum needed for commercial control should be used. In 1948, a single application of several different insecticides at the peak of adult migration not only gave effective control but resulted in almost negligible residues at harvest. In New York, migration occurs in late April and early May, when the clover plants are only a few inches high, and dust applied to these plants sifts down into the crowns, where it is most effective and is below the cutter bar at harvest time. The new growth that makes up most of the hay is thus largely free from insecticides. BHC at the rates tested did not reduce the palatability of the hay to livestock.

MUNRO (J. A.), LERAAS (M. A.) & NOSTDAHL (W. D.). **Biology and Control of the Sweet Clover Weevil.**—*J. econ. Ent.* **42** no. 2 pp. 318–321, 7 refs. Menasha, Wis., 1949.

Following its discovery in North America near Montreal in 1924, *Sitona cylindricollis*, Fåhr., has spread across Canada [*cf. R.A.E.*, **37** 124] and the northern United States from the eastern coast to the Rocky Mountains in areas in which sweet clover [*Melilotus*] is grown. It lives almost entirely on sweet clover, but feeds to a small extent on lucerne when forced by hunger. The adults defoliate the plants, whole fields being sometimes largely destroyed before the seedlings are sufficiently established to withstand the injury. The larvae feed on the rootlets, but apparently cause only slight damage. The weevil was first recorded in North Dakota in 1941 and spread over the entire state in two years ; in consequence, wild sweet clover practically disappeared and the acreage of sweet clover under cultivation decreased by 75 per cent., causing concern to farmers and bee-keepers. In 1948, wild sweet clover again became fairly common, probably owing to a low population of weevils per plant and high survival of seedlings in the previous year. Autumn surveys in infested areas in 1946, 1947 and 1948 showed the presence of 4·5, 7·8 and 6·25 weevils per sq. ft., and such surveys are considered a useful aid to forecasting weevil incidence. *S. cylindricollis* spreads largely by flight, chiefly in spring while there is a scarcity of plant growth [*cf.* **34** 29]. New seedlings near established fields of sweet clover suffer the greatest damage, and delaying sowing until after the third week of June, which usually marks the end of the main oviposition period, results in a fairly normal stand of plants, provided that rainfall or soil moisture is adequate for the seeds to germinate.

The weevils hibernate among plant residue on the soil surface or in cracks in the ground. Oviposition begins soon after they start feeding on the first green growth in the spring, and usually continues well into June. The females lay many eggs [*cf.* **37** 125], but comparatively few larvae hatch and complete their development ; many die soon after hatching while burrowing in the soil to feed on the rootlets. The eggs are scattered, chiefly in soil crevices near the base of the plants, and hatched in 12–27 days in the field. In 1948, larvae of a readily visible size were observed from 6th July until 7th September, and pupae from 30th July to 7th September. Usually, most of the weevils complete their development and emerge from the soil during the last week of July and the first week of August, but in 1948 the bulk of emergence was delayed until late August, and this delay and the increased amount of sweet clover present resulted in only slight or moderate feeding injury to the plants before the weevils entered hibernation.

Insecticide tests made in North Dakota in recent years showed that 55–75 per cent. control was given by dusts containing 3–5 per cent. DDT, 5 per cent. chlordan or 10 per cent. toxaphene at 20 lb. per acre or a toxaphene spray applied at the same rate of toxicant per acre. Benzene hexachloride, barium fluosilicate, DDD [dichlordiphenyldichlorethane], calcium arsenate, Paris green and parathion were progressively less effective in that order. Applications in late April were more effective than those made later; applications in early September, before the insects entered hibernation, or to new seedlings, gave no control. Shallow tillage in late July after the removal of the hay crop to expose the larvae and pupae to heat and drying is very effective. Seedlings are fairly safe from damage when situated half-a-mile or more from established fields of sweet clover, except when the weevils are exceedingly abundant and conditions favour flight. Varieties of sweet clover showed wide differences in resistance to *Sitona* [*cf.* **34** 30]. The weevils are destroyed by *Bufo cognatus* [*cf.* **33** 96] and sometimes by a naturally occurring fungus. In 1948, two parasites, the Braconid, *Microctonus aethiops*, Nees, and the Tachinid, *Campogaster exigua*, Mg., were introduced from France for release in infested fields near Fargo. Adults of *M. aethiops* of the first generation were subsequently recovered.

HOWE (W. L.). **Factors affecting the Resistance of certain Cucurbits to the Squash Borer.**—*J. econ. Ent.* **42** no. 2 pp. 321–326, 1 fig., 7 refs. Menasha, Wis., 1949.

The following is from the author's summary. At Geneva, New York, in 1948, squashes and pumpkins representing three varieties of *Cucurbita maxima*, five of *C. pepo* and five of *C. moschata* showed marked differences in resistance to attack by *Melittia cucurbitae*, Harr. [*cf. R.A.E.*, A **37** 416, etc.], and studies were made of the main factors involved. At the insect populations prevailing, all five varieties of *C. moschata* were highly resistant to attack, apparently because of avoidance by ovipositing moths and a low rate of larval establishment. These varieties were characterised by hard, compact, woody stems with closely arranged tough vascular bundles and an apparently inadequate food supply for normal larval development. All three varieties of *C. maxima* were relatively susceptible to attack because of moderately high attractiveness for oviposition and a mode of growth favouring larval entry and development. These varieties were also particularly susceptible to infection by organisms causing stem decay. Three trailing varieties of *C. pepo* were moderately resistant because of partial compensation for high ovipositional preference by moderate antibiotic influences of the plant tissues on larval development, resistance to the development and spread of rotting organisms, and moderate tolerance of infestation. Two bush varieties of *C. pepo* appeared to have slightly more resistance than the trailing varieties of the same species. In this case, higher preference for oviposition and lack of antibiotic influences towards larvae were largely offset by a high tolerance of infestation, due to the presence of an abundance of succulent tissue in large, fast-growing stems.

RAWLINS (W. A.), STAPLES (R.) & DAVIS (A. C.). **Wireworm Control with several Insecticides introduced into the Soil.**—*J. econ. Ent.* **42** no. 2 pp. 326–329, 3 refs. Menasha, Wis., 1949.

An account is given of experiments in various districts of New York in 1947 and 1948 on the control of *Limonius agonus*, Say, and *Agriotes mancus*, Say, attacking potatoes. The insecticides were applied in pyrophyllite or talc by means of a fertiliser spreader to soil prepared for planting, and the ground was harrowed in two directions with a disk or spring-toothed harrow after treatment. In 1947, crude BHC (benzene hexachloride) was used at 0·125, 0·25, 0·5, 1 and 2 lb. γ isomer per acre and chlordan and toxaphene at 2, 4, 8 and 16 lb. per acre. BHC did not give good control at the two lowest rates, but was effective in all cases at the others, and it is considered that dosages of 0·5–1 lb. γ isomer per acre would be sufficient at the prevailing population level. Chlordan gave good control at all rates tested, but toxaphene did not usually reduce injury appreciably.

The materials used in 1948 comprised crude BHC and a refined BHC from which impurities thought responsible for tainting had been removed, both at 0·5–2 lb. γ isomer per acre, chlordan at 2–8 lb. per acre, technical heptachlor [1(or 3a),4,5,6,7,8,8-heptachlor-4 : 7-methano-3a,4,7,7a-tetrahydroindene] at 0·5–8 lb. per acre and compound 118 (technical 1,2,3,4,10,10-hexachlor-1 : 4, 5 : 8-diendomethano-1,4,4a,5,8,8a-hexahydronaphthalene) at 2 and 4 lb. per acre. The last two compounds [*cf. R.A.E.*, A **38** 119] were ground to 50 per cent. powders. Crude BHC gave good control of low infestations at all rates, with no significant differences between treatments, and the refined BHC gave comparable results in all but one instance, though it appeared slightly less effective. Chlordan was rather ineffective at 2–4 lb. per acre against fairly heavy infestations but satisfactory against light ones, and gave consistently good control at 8 lb. Heptachlor was superior to chlordan at identical rates of application and gave economic control, even of heavy infestations, at 2–4 lb. per acre. Compound 118 gave promising results at 4 lb.

The variations of soil type encountered did not appear to have any effect on the toxicity of the insecticides to wireworms, and there appeared to be no difference between the two species in the control given by the various materials.

DRIGGERS (B. F.) & DARLEY (M. M.). **Control of Plum Curculio on Peaches with Benzene Hexachloride, Parathion, Chlordan and Lead Arsenate.**—*J. econ. Ent.* **42** no. 2 pp. 330–335, 9 refs. Menasha, Wis., 1949.

The following is substantially the authors' summary. Spray tests against the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach were continued in various districts in New Jersey in 1948 [*cf. R.A.E.*, A **38** 154]. In programmes of 2–5 applications made at ten-day intervals, various spray powders containing BHC (benzene hexachloride) at dosages providing 0·09–0·24 lb. γ isomer per 100 U.S. gals. gave at least as good control (as measured by the number of infested dropped peaches per tree) as parathion at 0·25 lb. per 100 U.S. gals., much better control than chlordan at 1 lb., and very much better control than acid lead arsenate at 2 lb. In tests in southern New Jersey, evidence was obtained that the efficiency of BHC spray powders in reducing reproduction by *C. nenuphar* on peach is increased by increasing the dosage of γ isomer, by making more frequent or more numerous applications, by reducing the particle size of the powder, or by the use of suitable spray coverage supplements. No differences in the results obtained with the various BHC spray powders tested could be attributed to differences in brand or in percentage or degree of refinement of their γ isomer content.

Special tests were made in southern New Jersey to obtain information as to how these new insecticides effect control under field conditions [*cf. loc. cit.*]. Evidence was obtained that the spray deposits given by BHC, parathion and chlordan spray powders are more repellent to the adults than those given by lead arsenate, with or without DDT, and that the organic insecticides possibly contribute more to control in this way than by killing the adults. At a dosage providing 0·18 lb. γ isomer per 100 U.S. gals., BHC was very effective in killing larvae in peach fruits, whether the infested fruits were sprayed on the tree or after having dropped to the ground. Parathion and chlordan were considerably less effective in this respect at 0·25 lb. and 1 lb. per 100 U.S. gals., respectively. Evidence was also obtained that the effectiveness of BHC, parathion and chlordan in killing the larvae in the fruit is greater the sooner they are applied after larval development begins.

Woodside (A. M.). **Tests of Insecticides for Control of Cat-facing on Peaches.**—*J. econ. Ent.* **42** no. 2 pp. 335–338. Menasha, Wis., 1949.

Cat-facing of peaches, caused chiefly by the tarnished plant bug [*Lygus oblineatus*, Say], which comes to the peach trees when they are in bloom or earlier and leaves them soon after the petals drop, and by Pentatomids of the genus *Euschistus*, which seldom become common until the shucks are splitting and usually leave by 1st June, results in considerable loss in Virginia. In 1946, sprays and dusts of DDT, activated sabadilla and BHC (benzene hexachloride containing about 12 per cent. γ isomer) were tested for its control. Four applications were made in one orchard and three in another, the first at petal-fall, and the percentages of scarred fruits were reduced by sprays of 2 lb. 50 per cent. DDT, 4 lb. 50 per cent. sabadilla and 3 lb. 31·6 per cent. BHC per 100 U.S. gals. from 25·5 and 27·2 to 9, 11·3 and 11·3 and 7·2, 2·2 and 4. Dusts containing 5 per cent. DDT, 10 per cent. sabadilla or 3·2 per cent. BHC were less effective and were not tested further.

Since these results indicated that considerable injury might be taking place before petal-fall, an extra spray at full-bloom was added in 1947. The same sprays of DDT and sabadilla and one of 3 lb. 50 per cent. BHC per 100 U.S. gals. were applied at full bloom, petal fall or both ; all treatments were effective and the petal-fall sprays were very slightly more effective than the full-bloom sprays, and the two together only a little better than either alone. The same sprays applied at the shuck-split stage, a week later or at both times were ineffective. In 1948, the sprays of DDT and BHC and one of 2·5 lb. 40 per cent. chlordan per 100 U.S. gals. were applied at full-bloom, petal-fall or both and a spray of 4 lb. 25 per cent. chlorinated camphene [toxaphene] at petal-fall. All treatments reduced the percentages of scarred fruits, DDT being the most effective, and the relative effectiveness of sprays applied at different times was the same as in 1947. It is concluded that sprays of DDT and sabadilla, applied either at full-bloom or at petal-fall, give satisfactory control and that in some seasons the petal-fall spray may be too late to prevent damage by *Lygus*.

Carlson (F. W.) & Newcomer (E. J.). **Control of Pear Psylla in the Pacific Northwest.**—*J. econ. Ent.* **42** no. 2 pp. 338–342, 4 figs., 3 refs. Menasha, Wis., 1949.

In view of the wide extent of infestation of pear by *Psylla pyricola*, Först., in the Pacific Northwest, the campaign for its eradication or the prevention of its spread to commercial pear-growing areas, organised by the U.S. Bureau of Entomology, was abandoned in 1947, and experiments on its control by summer sprays that could be applied by growers were carried out in British Columbia in that year and in Washington in 1948. The Bureau had already begun work with such sprays in New York [*R.A.E.*, A **36** 334 ; **37** 387].

All spray quantities are given per 100 U.S. gals., and the BHC (benzene hexachloride) used contained 12 per cent. γ isomer. In large-scale tests in 1947, sprays were applied on 7th June. One of 1·5 lb. 50 per cent. BHC greatly reduced the population, which afterwards increased rather slowly, one of 1 lb. of a product containing 1 per cent. rotenone not only greatly reduced infestation but prevented it from increasing for two months, and 0·75 U.S. pint nicotine sulphate with 2 U.S. quarts mineral oil was almost as effective. Tetraethyl pyrophosphate (9 per cent. tetraethyl phosphate and 16 per cent. other organic phosphates) applied at 0·5 U.S. pint practically eliminated the population at the time of application, but the nymphs increased rapidly after treatment ; a further application to these trees of 1·5 U.S. pints 50 per cent. emulsible chlorinated camphene [toxaphene] on 2nd July reduced the population to almost zero for more than a month.

In 1948, summer sprays were applied on 8th July in two orchards in which a heavy overwintering population of the Psyllid had been reduced to a low level by dormant sprays of 3·2 per cent. mineral oil in early April, so that numbers did not begin to increase until late June. Toxaphene (50 per cent.) at 1 U.S. pint had an initial efficiency (estimated from the reduction in numbers of nymphs) of 95–100 per cent. and kept the infestation below one nymph per spur for six weeks ; where 1·5 U.S. pints were used, the infestation remained below one nymph per spur for more than two months. Parathion (25 per cent.) at 2·5, 5 and 10 oz. showed an initial efficiency of 100 per cent. and kept the infestation well below one nymph per spur for 8–10 weeks, the standard spray of 0·75 U.S. pints nicotine sulphate and 2 U.S. quarts mineral oil kept it very low for six weeks, after which it rose slowly, and 1 lb. 1 per cent. rotenone with 2 U.S. quarts mineral oil gave similar results. A spray of 1 lb. BHC with 2 U.S. quarts mineral oil allowed infestation to rise rapidly after about six weeks, although its initial efficiency was 90–100 per cent. In a third orchard that was heavily infested in spring and received no dormant spray but did not develop a heavy summer infestation until August, sprays of 1·2 U.S. pints 42 per cent. toxaphene, 2·5 oz. 25 per cent. parathion or 0·75 U.S. pint nicotine sulphate, the last with 2 U.S. quarts oil, were applied on 3rd August. All had an initial efficiency of 100 per cent. and were still 98 per cent. effective on 25th August. By 24th September a heavy infestation had developed on the trees sprayed with toxaphene, but there were less than 5 nymphs per spur on the other treated trees as compared with 23 per spur on untreated ones.

In small-scale tests in 1947 and 1948, initial efficiency and efficiency after 30 days were 90 and 80 per cent. for 0·67 U.S. pint and 100 and 93·3 per cent. for 1·33 U.S. pints 1·5 per cent. rotenone, 99·5 and 99·5 per cent. for 5 oz. 25 per cent. parathion and 70·6 and 100 per cent. for 2 U.S. quarts 25 per cent. disodium ethylene bisdithiocarbamate hexahydrate, and rotenone was not improved by the addition of piperonyl cyclonene or piperonyl butoxide, alone or with pyrethrins. Chlordan, DDT, 1,1-bis(parachlorphenyl) ethanol, bis(parachlorphenoxy)methane, Lorol-2-thiazolinyl sulphide and mineral oil were less effective at the concentrations used but some of them might prove better at higher ones if lower costs make their use practicable.

Parathion, rotenone, nicotine sulphate, BHC and toxaphene did not injure pear fruit or foliage, though toxaphene scorched the leaves in Oregon when applied with or just after mineral oil and marked Comice fruits where drops of spray dried on them. Tetraethyl pyrophosphate caused some injury to foliage and fruits and one of the piperonyl compounds caused more serious fruit injury in 1947.

Bobb (M. L.). **Sprays for Control of the Peach Tree Borer.**—*J. econ. Ent.* **42** no. 2 pp. 343–345, 3 refs. Menasha, Wis., 1949.

Aegeria (*Sanninoidea*) *exitiosa*, Say, is the most injurious insect pest of peach trees in Virginia and has been the most difficult to control. The results are given of tests made in 1947–48 with DDT, chlordan and parathion, and the following is based on the author's summary. Applications during the period of adult emergence of sprays containing DDT to the trunks and crotches of peach trees proved effective against adults visiting the trees and against newly hatched larvae. Two applications, in early July and the middle of August, of sprays containing 4 lb. actual DDT per 100 U.S. gals. water gave over 90 per cent. control, and the residues remained toxic for nine weeks in 1947. Chlordan at 1 lb. per

100 U.S. gals. was less satisfactory than DDT and had a relatively short period of effectiveness. In 1948, two applications of parathion at 1 lb. 25 per cent. material per 100 U.S. gals. water gave complete control in an orchard with a light infestation and about 90 per cent. in a heavily infested orchard, and DDT was at least as effective. It is concluded that DDT trunk sprays have marked advantages over the treatments previously employed [*cf. R.A.E.*, A **37** 386].

NEWTON (J. H.) & LIST (G. M.). **Codling Moth and Mite Control in 1948.**—*J. econ. Ent.* **42** no. 2 pp. 346–348, 4 refs. Menasha, Wis., 1949.

The codling moth [*Cydia pomonella*, L.] has been extremely difficult to control on apple in western Colorado, since the local strain is resistant to many insecticides [*cf. R.A.E.*, A **32** 350]. The use of DDT is giving better results, but is attended by an increase in mites, of which the most important are *Bryobia praetiosa*, Koch, and *Tetranychus* spp., and attempts were therefore made to develop a programme that was effective against both the moth and the mites.

The sprays were tested in an orchard in which no dormant or calyx applications were made and *Bryobia* was the only abundant mite ; all spray quantities are per 100 U.S. gals. DDT was used at 1½ lb. and methoxy-DDT (methoxychlor) at 3 lb., and one or other of several potential acaricides was included in all sprays containing them. The results showed that four applications of DDT provided the most effective schedule for codling-moth control ; the least effective was two applications of 3 lb. lead arsenate with kerosene and soap against the first brood followed by two of 3 lb. fixed nicotine and 1 U.S. quart summer oil against the second, which permitted about four times as many larvae to enter the fruits. The DDT schedule gave significantly better control than four applications of 1 or 2 lb. 25 per cent. parathion, which were almost equal in effect and rather better than four of methoxy-DDT. Results from combinations of DDT with 0·75 lb. triethanolamine salt of dinitro-o-cyclohexylphenol, 1 U.S. quart potassium ammonium selenosulphide, 6–8 lb. wettable sulphur or 2·5 oz. 25 per cent. parathion did not differ significantly from one another, but 1 lb. bis(parachlorphenoxy) methane in the first three sprays reduced the efficiency of the DDT. Two applications of DDT were very inadequate ; four were very significantly better than three, but five (the fifth at 1 lb.) were not significantly better than four. The wettable sulphur and dinitro and selenium compounds in the DDT sprays and the sprays of 1 or 2 lb. 25 per cent. parathion gave effective and approximately equal control of *Bryobia*, but 2·5 oz. 25 per cent. parathion in a DDT spray did not give significant mite control. Combinations of 1 U.S. pint IN-4200 (alkyl-2-thiazolinyl sulphides) with methoxy-DDT and of 1 lb. bis(parachlorphenoxy)methane with DDT gave little if any control of the mite ; the spray containing IN-4200 caused severe foliage injury, and though the other spray did not, the fruits showed discoloured spots at harvest, lost moisture rapidly and shrivelled in storage. Treatment with fixed nicotine and summer oil gave partial but unsatisfactory control of *Bryobia*.

COCHRAN (J. H.). **Comparative Effectiveness of various organic Insecticides against the Oriental Fruit Moth.**—*J. econ. Ent.* **42** no. 2 pp. 348–350. Menasha, Wis., 1949.

The results are given of field tests of DDT, methoxy-DDT, DDD (dichlordiphenyldichlorethane) and parathion on peach in South Carolina against the oriental fruit moth [*Cydia molesta*, Busck] and also the second generation of the curculio [*Conotrachelus nenuphar*, Hbst.], which was numerous enough to be included. Sprays containing 2 lb. 50 per cent. wettable DDT, methoxy-DDT or DDD or 6 or 12 oz. 25 per cent. wettable parathion per 100 U.S. gals. were applied at approximately 4 U.S. gals. per tree on 16th–17th and 30th June. The best results against both insects were given by parathion at the higher concentration, and parathion and methoxy-DDT were the only materials that significantly reduced the total percentage of infested fruits at harvest and that showed promise against *Conotrachelus*. All treatments caused reductions of *Cydia*, parathion being more effective than DDT and DDT slightly more so than methoxy-DDT or DDD, neither of which gave significant control; reducing the quantity of DDT in the second spray from 2 to 1 lb. per 100 U.S. gals. did not affect the results.

Driggers (B. F.) & Merrill jr. (L. G.). **Oriental Fruit Moth Control with DDT and Parathion.**—*J. econ. Ent.* **42** no. 2 pp. 351–354. Menasha, Wis., 1949.

In the course of experiments on the control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach in central and northern New Jersey in May and June 1948, it was observed that sprays of parathion applied at the shuck-off stage and ten days later gave good control of the first generation of the oriental fruit moth [*Cydia molesta*, Busck] in fruits and twigs. Experiments were therefore carried out to compare parathion with DDT against the second and third generations of the moth.

In central New Jersey, plots were sprayed with 1 lb. 25 per cent. wettable parathion or 2 lb. 50 per cent. DDT per 100 U.S. gals. on 20th June against the second generation and on 15th July and 6th August against the third, or with the DDT spray on the last two dates only. The percentages of injured fruits on unsprayed trees of four varieties harvested about 1–4 weeks after the last spray date ranged from 40·4 to 92·2 per cent. Parathion reduced the injury to less than 7 per cent. on all varieties, and though DDT was only slightly less effective on varieties harvested within three weeks, it was much less so on that harvested after four. The extra spray applied against the second generation did not materially improve control. In northern New Jersey, where sprays were applied with a speedsprayer [*R.A.E.*, A **34** 195] on 24th June against the second generation and on 23rd July and 7th August against the third, similar results were obtained, but the indications were that sprays of either material were not very effective after 2–3 weeks.

Graham (C.). **Control of the Red-banded Leaf Roller.**—*J. econ. Ent.* **42** no. 2 pp. 354–356. Menasha, Wis., 1949.

The following is based on the author's introduction and summary. In the course of experiments on the control of the codling moth [*Cydia pomonella*, L.] and the European red mite [*Paratetranychus pilosus*, C. & F.] on apple in Maryland, observations were made on the effect of different spray schedules on *Eulia* (*Argyrotaenia*) *velutinana*, Wlk. All but one plot received a delayed dormant application of 3 per cent. oil emulsion. Parathion applied at 1 lb. 25 per cent. wettable powder per 100 U.S. gals. gave practically complete control of the first generation of the leaf roller when used in the petal-fall and first cover sprays, but four applications of 1 lb. DDT or 1 lb. 40 per cent. chlordan proved unsatisfactory. Four applications of 3 lb. lead arsenate with 3 lb. lime gave fair control of the injury to fruit, but permitted infestation of the water sprouts throughout the first generation, and it is considered that the low toxicity of lead arsenate to the larvae on foliage would permit the development of large second and third generations that would require several additional sprays to give satisfactory control. The omission of the delayed dormant oil spray caused a noticeable increase in leaf-roller population. DDD (dichlordiphenyldichlorethane), applied once on 14th or 26th July at the rate of 1 quart or 1 pint 25 per cent. emulsion concentrate per 100 gals., respectively, gave excellent control of the second generation of *E. velutinana*, in experimental plots, and no additional injury occurred from either the second or third generations in commercial orchards receiving one application of DDD. DDD at 1 lb. 50 per cent. wettable powder per 100 U.S. gals. was about equal in effectiveness to 1 U.S. pint of the emulsion concentrate, but 0·5 lb. powder did not give satisfactory control. Parathion gave complete control of the second generation when applied in July at 1 lb. 25 per cent. wettable powder but was somewhat less effective at 0·5 lb.

NICKELS (C. B.). **DDT and other Insecticides to control the Pecan Nut Casebearer.**—*J. econ. Ent.* **42** no. 2 pp. 357–359. Menasha, Wis., 1949.

Experiments with various insecticides for the control of *Acrobasis caryae*, Grote, on pecan were carried out in Texas in 1946–47. All spray quantities are given per 100 U.S. gals. In field tests on severely infested trees in the south of the state, treatments were begun in late April or early May, when about 25 per cent. of the first generation eggs had hatched but few larvae had entered the nuts, and zinc sulphate was added to all sprays and applied to the trees receiving no insecticide. In 1946, the greatest percentage of nuts retained in marked clusters in October (48·6) and the highest yield per sq. ft. of trunk section (35·7 lb.) were on trees sprayed with 1·5 lb. micronised DDT on 29th April and 6 lb. lead arsenate on 4th May, and a single application of 6 lb. lead arsenate, 13 fl. oz. nicotine sulphate and 3 U.S. quarts summer oil, which was the next most effective, was better than treatment with DDT alone or nicotine sulphate with summer oil. In 1947, the highest yield of one variety sprayed on 7th and 13th May (49 lb.) was from trees receiving two applications of 3 lb. 14 per cent. fixed nicotine, and treatments comprising two applications of 1 lb. DDT or one of 1 lb. DDT followed by one of 13 fl. oz. nicotine sulphate with 2 U.S. quarts summer oil were also very effective; all trees receiving these sprays retained 32 per cent. of the nuts in marked clusters. Untreated trees retained 15 per cent. of nuts and yielded 20 lb. per sq. ft. On two other varieties sprayed on the first date only, the addition of summer oil to 1·5 lb. DDT did not improve the yield, but the addition of 3 lb. of a BHC (benzene-hexachloride) powder containing 5 per cent. γ isomer increased it from 45 to 61 lb.

No injury to the trees resulted from any of the treatments tested, and Aphids and mites did not become particularly abundant at any time.

Late summer applications of 2·5–3 lb. DDT, 4–5 lb. BHC (7·7 per cent. γ isomer) and 6 lb. lead arsenate, applied primarily against the pecan weevil [*Curculio caryae*, Horn] materially reduced the numbers of larvae of *A. caryae* that went into winter quarters, but 1 U.S. quart 44 per cent. emulsifiable chlordan concentrate did not. In laboratory tests with sprays against the eggs, the percentage hatch was reduced from 98 for no treatment to 1 by about 4·5 lb. BHC (7·7 per cent. γ isomer), from 96 to 14 by 8 fl. oz. hexaethyl tetraphosphate (100 per cent.) with 1 lb. DDT, and from 98 to 0 by 8 fl. oz. hexaethyl tetraphosphate (containing 11·2 per cent. tetraethyl pyrophosphate) with 1 lb. DDT and 2 U.S. quarts summer oil.

CUTRIGHT (C. R.) & PARKS (T. H.). **Combating the Periodical Cicada with Insecticides.**—*J. econ. Ent.* **42** no. 2 pp. 359–362. Menasha, Wis., 1949.

In 1948, Brood V of *Magicicada septendecim*, L., emerged over nearly all the eastern half of Ohio and was very abundant and injurious to orchards in some areas. Fruit trees 1–3 years old were severely damaged and sometimes destroyed by oviposition wounds, and mature trees suffered serious injury on 2–3-year-old wood; this sometimes interfered with fruit development. Emergence from the ground began on 15th May in southern Ohio and about 26th May in the north-eastern counties and continued for a considerable time. The preoviposition and oviposition periods lasted about ten and 15–18 days, and damage was caused for 3–4 weeks.

Laboratory tests, in which cicadas were dipped in solutions of the test materials, and tests in which wire-mesh cages containing ten cicadas were hung in orchard trees and sprayed, showed that DDT and chlordan, each at 4–8 lb. 50 per cent. wettable powder per 100 U.S. gals., and chlordan at 3·2–6·4 gals. 50 per cent. emulsion concentrate per 100 gals. gave very poor control, and that chlorinated camphene [toxaphene] was also ineffective. A powder containing 25 per cent. γ BHC (benzene hexachloride) at 1–2 lb. per 100 U.S. gals. acted slowly but usually gave 50–100 per cent. kill in 40–45 hours. HETP (hexaethyl tetraphosphate) at 3–12 oz. per 100 U.S. gals. and TEPP (tetraethyl pyrophosphate) at 3–16 oz. were effective and rapid in action, and 2–4 lb. 25 per cent. parathion was effective but less rapid.

In field tests, sprays of 4 lb. 50 per cent. wettable DDT, chlordan or toxaphene, 4 lb. BHC powder (6 per cent. γ isomer), 1 U.S. pint nicotine sulphate or 1½ lb. 15 per cent. parathion per 100 U.S. gals. were all ineffective, but 40 per cent. TEPP was effective on young peach trees at 2 oz. per 100 U.S. gals. and on large trees at 4 oz. [*cf. R.A.E.*, A **38** 17]. In a severe infestation, it was necessary to repeat the application at least twice because of migration from woods and continued emergence from the soil, and even this did not prevent some damage from oviposition. Sprays of 1 U.S. pint. 50 per cent. HETP or 8 oz. 20 per cent. TEPP per 100 U.S. gals. were also effective. The sprays had to be applied immediately after being mixed in the tank and directly on the cicadas. The best results were obtained with a heavy spray fog that quickly enveloped the tree; speedsprayers [*cf.* **34** 195] were very satisfactory when slowed down to give adequate coverage. The phosphate sprays gave no residual protection; they caused no damage to the foliage even when lead arsenate and the mild sulphurs were mixed with them, but the addition of lime rendered them ineffective. One spray operator was affected by TEPP, but most experienced no discomfort if they avoided the spray fog and sprayed with the wind. Very young trees should have been covered with cheesecloth at the beginning of the infestation, as the continued migration of cicadas and those that escaped the spray caused too much damage to them.

CUTRIGHT (C. R.). **The Use of Acaricides in Concentrate Form.**—*J. econ. Ent.* **42** no. 2 pp. 363–365. Menasha, Wis., 1949.

The European red mite [*Paratetranychus pilosus*, C. & F.] is a serious problem in apple orchards in Ohio, the most thorough type of spraying with the most effective materials being required for good control, and experiments with concentrated acaricides were therefore carried out in 1948. Two experimental sprayers, in which the finely divided concentrate is introduced into a large volume air blast by nozzles or other means, were used. In one test on well-grown apple trees, 20 per cent. dicyclohexylamine salt of dinitro-o-cyclohexylphenol (DN-111), bis(parachlorphenoxy)methane (Neotran), 25 per cent. parathion (Thio-fos) and alkyl-2-thiazolinyl sulphides (IN 4200) were applied on 22nd July and 3rd August at concentrations of 20, 20, 5 and 12 oz., respectively, per 100 U.S. gals. by the regular high-pressure sprayer or a regular air-blast sprayer and at five times these concentrations by the concentrate sprayer. The quantities of spray per tree were about 20 U.S. gals. for the first two and 3–4 for the last. The results indicated that the acaricides were as effective when applied as concentrates as at normal dilutions, and careful inspection of the trees during and after the experiment showed no injury to fruit or foliage on any plot. All treatments gave good reductions in population.

In another test on smaller trees, IN 4200, Thio-fos and 40 per cent. dinitro-o-cyclohexylphenol (Dry Mix No. 1) at 12, 5 and 6 oz. per 20 U.S. gals., respectively, and at twice these concentrations (ten times normal strength) were applied on 4th August with a concentrate sprayer at the rate of about 3 U.S. gals. spray per tree for the low concentration and 1·5 for the high one. The higher concentrations were very effective, but not significantly more so than the lower ones. There was no foliage or fruit injury. At the same time, DN-111, Neotran and di(parachlorphenyl)methyl carbinol (Dimite) were also applied at ten times the normal concentration, and all gave good reductions of the mite and caused no injury, except for DN-111, which caused typical scorching of the leaves but did not affect the quality of the crop at harvest.

In the final tests, concentrated sprays containing 20, 20, 12 and 5 oz. Neotran, DN-111, IN 4200 and Thio-fos, respectively, per 20 U.S. gals., applied once in July at 4 U.S. gals. spray per tree, gave excellent control on fully grown trees and compared favourably with regular high-pressure sprays in a neighbouring orchard, in which the amount of spray used per tree was 33 U.S. gals.

ADAMS (J. A.). **The Oriental Beetle as a Turf Pest associated with the Japanese Beetle in New York.**—*J. econ. Ent.* **42** no. 2 pp. 366–371, 12 refs. Menasha, Wis., 1949.

The following is substantially the author's summary. Where damage to turf by Lamellicorn larvae was investigated in the neighbourhood of New York City in 1947 and 1948, it was found that the chief components of the population were usually *Anomala orientalis*, Waterh., *Aserica* (*Autoserica*) *castanea*, Arr., and *Popillia japonica*, Newm., and that *Anomala orientalis*, though very unevenly distributed, was frequently the predominant species. The public tended to attribute the new turf damage to *P. japonica* alone and to discredit the programme adopted for the control of that species by the distribution of spores of *Bacillus popilliae*, the organism causing milky disease. Milky disease was found in as many as 5 per cent. of the larvae of *A. orientalis* dug in the autumn in areas in which the spore powder had been applied several years before, but its incidence in larvae of *Popillia* and *Anomala* in the autumn was insufficient to protect turf from injury by mixed populations that also included *Aserica castanea* and, in a few cases, *Cyclocephala borealis*, Arr.

On a series of single plots dusted on 20th May 1948 and examined in the autumn, practical control of *Anomala orientalis* was obtained with DDT applied at about 26 lb. per acre, with chlordan at 5·4 and 10·8 lb. per acre and with a mixture of DDT at 13 lb. and chlordan at 5·4 lb. per acre. Parathion was also applied at 4 lb. per acre ; it was not known whether it gave a kill in the month following application, but it was found to have provided partial control of the new generation of larvae in October. In another test, a 50 per cent. chlordan powder applied dry with a patented turf duster in April at a rate to give 10 lb. toxicant per acre to turf infested by a mixed population seemed to give practical control of larvae of *P. japonica* of the overwintering generation by late June and full control of the new generation, which consisted largely of *Anomala* larvae, by October. Observations were also made on golf courses reported as treated in April with 50 lb. 50 per cent. DDT powder per acre, applied with the turf duster. The indications were that the treatment did not give substantial control of the overwintering generations of either species but that the new generations were controlled in the autumn. No special recommendations for chemical control of *A. orientalis* in turf, different from those for *P. japonica*, seem necessary.

STONE (P. C.). **Drug Store Beetle infecting Calf Starter Pellets.**—*J. econ. Ent.* **42** no. 2 p. 371. Menasha, Wis., 1949.

Sitodrepa (*Stegobium*) *panicea*, L., is known to infest nearly all dry plant and animal products, but has previously been of little economic importance while breeding in grain products. Recently a 25-lb. bag of highly nutritious calf starter pellets, purchased from a shop in Missouri, was found to be heavily attacked by it ; every pellet was infested, and some had six rounded burrows from which the insects emerged. All stages of the beetle were present within the pellets as well as two species of Hymenopterous parasites and many active examples of a Cheyletid mite. Several generations had developed in the bag, and many beetles had cut exit holes in the cloth.

PRITCHARD (A. E.) & BEER (R. E.). **Parathion for Control of Pests of ornamental and flowering Plants.**—*J. econ. Ent.* **42** no. 2 pp. 372–379, 5 refs. Menasha, Wis., 1949.

Parathion was tested extensively in sprays in commercial greenhouses and nurseries in the San Francisco Bay region of California for two years. The following is substantially the authors' summary of their account of the results obtained and of limited observations on the use of commercial parathion spray materials and liquefied-gas aerosols by growers. Extensive experimental work with commercial crops of ornamental and other flowering plants showed that parathion sprays are very effective for the control of *Tarsonemus pallidus*, Banks, spider mites, Lepidopterous larvae, thrips, Aphids, *Trialeurodes vaporariorum*, Westw., mealybugs, armoured scales and certain stages of soft scales when occurring under relatively exposed conditions. The sprays were ineffective against false spider mites (*Tenuipalpus* and *Brevipalpus*) and many mites and insects that were protected by plant tissue, though single applications completely controlled the azalea leaf-miner, *Gracillaria azaleella*, Brants. Plants of a very wide variety were found to be tolerant to insecticidal concentrations of the parathion wettable powder that was furnished for experimental purposes. Ferns, poinsettias and African violet blossoms were the most sensitive to injury. Roses, gardenias and stephanotis often suffered leaf drop as a result of applications of several different commercial spray materials or liquefied-gas aerosols by growers.

No adverse effects to the operator were noted when a respirator was worn and other reasonable precautions were taken during the application of parathion sprays or to employees working with crops that had been treated.

HAMMER (O. H.). **The Triethanolamine Salt of Dinitro-o-sec-butylphenol to control certain Pests on Fruit Trees.**—*J. econ. Ent.* **42** no. 2 pp. 380–383. Menasha, Wis., 1949.

The following is based on the author's summary. Numerous tests were carried out in orchards in Michigan in 1942–48 on the control of various insects and *Paratetranychus pilosus*, C. & F., with dormant sprays of an aqueous solution containing 8 oz. dinitro-o-sec.-butylphenol per U.S. quart, as the triethanolamine salt. When used in the spring-dormant period in water only, this preparation gave good control of *Anuraphis roseus*, Baker, on apple, *Myzus cerasi*, F., on cherry, *Hyalopterus arundinis*, F., on plum and *Capitophorus ribis*, L., on currant at a concentration of 1 quart per 100 gals. and of *Spilonota ocellana*, Schiff., on apple, *Coleophora pruniella*, Clem., on cherry and *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., on apple and currant, and moderate infestations of *Chionaspis furfura*, Fitch, and *Lepidosaphes ulmi*, L., on apple at 2 quarts, though severe infestations of the last two sometimes required 3 quarts. It was effective against *Psylla* (*Psyllia*) *pyricola*, Först., on pear, when applied at the green-tip stage at 2 quarts per 100 gals. and gave a high kill of the eggs of *Paratetranychus pilosus* on apple, plum and prune when used during the spring-dormant period at 2–4 quarts per 100 gals.

Dormant peach buds and terminal wood were severely injured by spring-dormant sprays containing as little as 1 pint concentrate per 100 gals., and moderate to severe injury of buds on apple, plum and prune resulted from spring-dormant sprays containing 1–3 per cent. oil with any amount of the salt. However, 0·5 and 0·25 per cent. oil emulsions combined with similar amounts of the solution were generally safe and should be investigated further, since sprays of this type appeared to be slightly more effective against Coccids and eggs of *P. pilosus* than the aqueous solutions alone.

SCHREAD (J. C.). **Residual Activity of Insecticides in Control of Turf Insects.**—*J. econ. Ent.* **42** no. 2 pp. 383–387, 2 refs. Menasha, Wis., 1949.

Observations were made in Connecticut in the summer and autumn of 1948 on the extent to which insecticides applied to soil for the control of larvae of the Japanese beetle [*Popillia japonica*, Newm.] in 1946 and 1947 [*cf. R.A.E.*, A **37** 395] had retained their effectiveness. Turf treated with 250 lb. 10 per cent. DDT dust per acre in May 1946 was still being protected, but parathion dust, applied at 1, 4 and 8 lb. technical compound per acre in August or September 1947 had lost its effectiveness in less than 12 months. Of various insecticides applied in May 1947, toxaphene dust was still giving complete control at 20–24 lb. toxicant per acre, almost complete control at 16 lb. and about 75 per cent. at 8–12 lb., benzene hexachloride, applied as a wettable-powder suspension at 0·96, 1·92, 2·88, 3·84 and 4·8 lb. γ isomer per acre, was giving complete control at the three highest rates and about 75 per cent. at the others, and chlordan dust, applied at 8–24 lb. toxicant per acre, was still giving complete control at all rates. Chlordan had retained sufficient toxicity to *Lasius niger* var. *americanus*, Emery, to prevent significant re-establishment of that ant at the end of a year. At the prescribed dosage levels, the insecticides discussed did not injure grass, but at extremely high dosages, chlordan temporarily retarded clover and bent grasses.

Further tests begun in May 1948 confirmed the superiority of toxaphene over DDT against *P. japonica* [*cf. loc. cit.*]. Parathion at 4 and 8 lb. per acre again gave rapid mortality and retained sufficient toxicity to destroy almost all larvae of the following generation during the summer and early autumn, though the amounts in the top inch of soil were only 0·2 and 0·6 parts per million, respectively, in early November.

CULLINAN (F. P.). **Some new Insecticides—their Effect on Plants and Soils.**—*J. econ. Ent.* **42** no. 2 pp. 387–391. Menasha, Wis., 1949.

The author reviews the results of investigations in progress in various parts of the United States on the effect on plants of DDT, benzene hexachloride, chlordan and toxaphene present in the soil in which they are grown or applied directly to them as for insect control. Four years after DDT and other chlorinated hydrocarbons were incorporated in the soil, these materials or others derived from them were still toxic to plants, the degree of toxicity varying with different soil types. Some plants were more susceptible than others, and there were differences even within varieties. When applied to plants, the compounds frequently caused changes similar to those obtained from more active growth-modifying chemicals, such as 2,4-dichlorphenoxyacetic acid. A considerably expanded research programme carried out under various soil and climatic conditions with various crops is considered necessary as a basis for more satisfactory soil-management and crop-protection practices.

BALL (H. J.) & ALLEN (T. C.). **Insecticidal Tests of some new organic Phosphates.**—*J. econ. Ent.* **42** no. 2 pp. 394–396, 10 refs. Menasha, Wis., 1949.

The results are given of laboratory tests in Wisconsin in which two of the newer phosphates were compared with parathion and technical tetraethyl pyrophosphate against various insects. When applied in an oil base, diethyl paranitrophenyl phosphate, parathion (O, O-diethyl O-paranitrophenyl thiophosphate), tetraethyl dithiono pyrophosphate, and technical tetraethyl pyrophosphate caused 86, 43, 3·3 and 1·7 per cent. mortality of *Musca domestica*, L., at a concentration of 1 : 8,000 and 65, 10, 3·3 and 0 per cent. at 1 : 16,000. In water, they gave 100, 94, 88 and 43 per cent. kill of *Macrosiphum solanifolii*, Ashm., at 1 : 8,000 and 88, 50, 29 and 12 per cent. at 1 : 32,000; and 100, 90, 85 and 65 per cent. kill of *Oncopeltus fasciatus*, Dall., at 1 : 250 and 70, 0, 0 and 0 at 1 : 4,000. Deposits of all four materials from water solutions applied to petri dishes at a concentration of 1 : 500 were tested against *O. fasciatus*; deposits of diethyl paranitrophenyl phosphate and parathion showed toxicity after eight days, but not after twelve, and tetraethyl dithiono pyrophosphate showed some toxicity after four days and tetraethyl pyrophosphate none.

The superiority of diethyl paranitrophenyl phosphate over parathion was further shown in tests with dusts in which the former was used at dilutions of 0·0025–0·00063 and the latter at 0·01–0·0025. At 0·0025, diethyl paranitrophenyl phosphate gave 100 and 97 per cent. mortality of *M. onobrychis*, Boy. (*pisi*, Kalt.) and *M. solanifolii*, respectively, as compared with 47 and 57 per cent. for parathion, and it gave 100 per cent. mortality of *Blattella germanica*, L., at 0·00063, as compared with 60 and 100 per cent. for parathion at 0·0025 and 0·005.

It is concluded that diethyl paranitrophenyl phosphate has promising qualities as an insecticide. Its superiority to parathion may be due to the substitution of oxygen for sulphur in the phosphate radical. It is a light yellow liquid with practically no odour, has a specific gravity of 1·269 and is soluble in most organic solvents, but fairly insoluble in spray oils unless a mutual solvent is added. At normal temperatures it is stable to hydrolysis. Tetraethyl dithiono pyrophosphate appears to be more insecticidal than technical tetraethyl pyrophosphate, but compares unfavourably with diethyl paranitrophenyl phosphate or parathion.

Phytotoxicity tests with several market-garden crops grown under field conditions showed the new materials to be quite safe at insecticidal levels. It is not known to what extent their use may involve poison hazards to plants and animals or their products, but their high toxicity to insects at low concentrations warrants their further consideration as insecticides.

WADLEY (F. M.). **An Application of Double Sampling in evaluating Insect Infestations.**—*J. econ. Ent.* **42** no. 2 pp. 396–397, 1 ref. Menasha, Wis., 1949.

In many biological and agricultural investigations, the labour of determining results is a limiting factor. In some cases, such as the examination of *Citrus* fruits for scale infestation, double sampling may be applied. For this, large numbers of fruits taken at random from each plot are separated rapidly into several categories, such as uninfested and lightly, moderately and heavily infested, and a random subsample of a few fruits is taken from each class for careful counting of the insects on each fruit. Multiplying the proportions of each class by its average number of insects will give an unbiased estimate of insect population with a limited amount of labour, and such a procedure used on a large number of fruits may result in a more accurate evaluation than a complete count on a smaller number.

The author describes the application of a development of this method in sampling maize ears for damage by the corn earworm [*Heliothis armigera*, Hb.].

King (H. L.) & Hutson (R.). **Further Studies on Control of Red-banded Leaf Roller with Parathion.**—*J. econ. Ent.* **42** no. 2 pp. 398–399, 1 ref. Menasha, Wis., 1949.

In further experiments on the control of *Eulia* (*Argyrotaenia*) *velutinana*, Wlk., on apple in Michigan in 1948 [*cf. R.A.E.*, A **38** 68], the trees received standard uniform applications of wettable sulphur and lead arsenate during the pre-bloom and calyx periods and five cover sprays of experimental materials in June and July. Wettable sulphur was applied to all plots in the first three cover sprays. Insecticide concentrations are per 100 U.S. gals. Sprays containing 2·5 or 1 lb. 25 per cent. parathion wettable powder, or 3 lb. lead arsenate with 1 lb. zinc sulphate and 4 lb. lime, all gave significant control with no significant difference between them, reducing the percentage of leaf-roller injury on the fruits at harvest from 9·4 to 0·7, 1·7 and 2, respectively, and one of 2 lb. 50 per cent. DDT wettable powder reduced it to 4·3, which was significantly better than no treatment, but significantly less effective than any other treatment. There were no significant differences in yield attributable to treatment. The higher concentration of parathion caused severe spray injury to the fruits and the low one caused some injury. Chemical analysis indicated negligible residues of parathion on fruits four weeks after spraying.

Li (Peng-Fi) & Larson (R. E.). ***Meligethes aeneus* as a Factor in Muskmelon Breeding Program in Pennsylvania.**—*J. econ. Ent.* **42** no. 2 p. 399. Menasha, Wis., 1949.

Self-pollination of musk melons in two fields in Erie County, Pennsylvania, during 1st–20th July 1948 resulted in 21·43 and 25·93 per cent. set of fruit when the work was done in the morning and only 9·38 and 5·63 per cent. when it was done in the afternoon. Careful observations in the fields revealed that beetles identified as *Meligethes aeneus*, F., were destroying the stamens. This European Nitidulid has been recorded from California, Oregon, Indiana and New York, but not previously from Pennsylvania. The beetles appeared at about 10 a.m., fed on the pollen grains in the mature flowers, and had practically emptied the anthers by noon. Dissection and microscopic examination of freshly opened mature flowers showed that 90 per cent. of those collected at 8 a.m. had abundant pollen and 10 per cent. had a moderate amount, whereas 76 per cent. of those collected at 1 p.m. had no pollen and 24 per cent. had a small available supply. For the remainder of the season, self-pollination was carried out only in the early morning and was stopped as soon as the beetles appeared. Of the flowers treated between 21st and 31st July, 48·78 and 54·14 per cent. set fruit, showing an average increase for both fields of 118·21 per cent.

Brown (A. W. A.). **The Relation to Toxicity of Boiling Point of Low Vapour Pressure Fumigants.**—*J. econ. Ent.* **42** no. 2 pp. 399–401, 1 fig., 7 refs. Menasha, Wis., 1949.

The author provides evidence supporting the view that the relation between the boiling point of fumigants and their toxicity to insects is primarily a relation between the boiling point of the compound and its consequent vapour pressure [*cf. R.A.E.*, A **37** 412], and raises a new point in connection with fumigants that have vapour pressures of less than 0·3 mm. of mercury and show median lethal concentrations of less than 4 mg. per litre when tested against adults of *Tribolium confusum*, Duv., if purely physical poisons or less than 1 mg. per litre if chemical poisons [*cf. loc. cit.*].

He lists fumigants that may be classed as physical poisons, showing their boiling point, vapour pressure, median lethal molar concentration to adults of *T. confusum* (C_t), saturation concentration (C_s) and relative saturation at which the vapour is toxic or toxic thermodynamic activity (C_t/C_s), and plots the boiling points against the logarithm of the molar saturation values and against the logarithm of the median lethal molar concentrations. The list shows C_t/C_s as greater than 1 for fumigants with boiling points of 207°C. or higher and less than 1 for those with boiling points of 203°C. or lower, and the slopes of the straight lines obtained indicate that the saturation value (C_s) decreases 50-fold for every 10°C. rise in boiling point of the compounds concerned whereas the toxic concentration (C_t) decreases 90-fold for every 10°C. rise in boiling point, so that C_t/C_s tends to increase as the boiling point rises and the vapour pressure falls. It is considered, however, that these values have been falsified by the adsorption of much of the added vapour on the walls of the fumigating vessel, as a result of which the vapour dose available to the insects is considerably less than that assumed on the basis of the amount of material added to the container. The assumed or nominal concentrations of compounds of very low vapour pressure will thus often prove to exceed the known saturation concentration figures. The factor of adsorption, which increases as the volatility of the compounds decreases, becomes particularly important for materials of low vapour pressure. All of the compounds tested that had boiling points higher than 200°C. proved lethal to *Tribolium* adults in concentrations at or slightly below saturation when administered in a constant-flow apparatus, the mortality after exposure for five hours being usually 100 per cent. and never below 50 per cent., provided that the insects were not separated from the source of the vapour by too great an extent of glass tubing or cage material. On the other hand, a glass vessel that was filled with the vapour and then tested with *Tribolium* adults did not give more than 15 per cent. mortality, presumably owing to loss of vapour by adsorption on the glass walls. Adsorption is therefore responsible at least in part for the steepness of the slope of the line showing the relationship between toxicity and boiling point in the case of compounds of low volatility, and may be regarded as a factor causing the increase in the relative saturation required to kill (C_t/C_s) with increase in boiling point. It has been considered [*cf. loc. cit.*] that this increase is implicit in the decrease of toxicity with ascent of a homologous series, but in view of these results, much of this increase may be an illusion in the case of insect fumigants, due to adsorption on the container, so that, instead of toxicity disappearing at a value for C_t/C_s of unity, it may continue at apparent values considerably in excess of this, where the nominal vapour concentration simultaneously satisfies the adsorptive capacity of the container and maintains a true vapour concentration sufficient to kill the insects.

These relationships apply to fumigants of which the action may be classed as physical. The more active chemical poisons show much lower C_t/C_s values, though some fumigants classifiable as chemical poisons that have low vapour pressures show values that are unusually high for chemical poisons, owing to the factor of adsorption. Some of these are listed with their properties.

Griffiths jr. (J. T.) & Stearns (C. R.). **A further Account of the Effects of DDT when used on *Citrus* Trees in Florida.**—*Florida Ent.* **30** no. 1–2 pp. 1–8, 1 fig., 3 refs. Gainesville, Fla., 1947.

The following is largely based on the authors' summary. As it had been observed in Florida that populations of *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) on *Citrus* increased after the trees had been sprayed with DDT, which almost eliminates its parasites and predators [*R.A.E.*, A **37** 152], further experiments were carried out during the late summer of 1946. Plots of *Citrus* that had been sprayed with DDT in April and on which the numbers of *C. ficus* had subsequently shown a marked increase were sprayed with a 1 per cent. oil emulsion with or without the addition of 4·8 oz. DDT per 100 U.S. gals. on 25th July and again on 21st August or left untreated. The predacious Coccinellid, *Chilocorus stigma*, Say, was virtually eliminated on the trees that received DDT, but was not materially affected by the oil spray. Infestation by *Chrysomphalus* was reduced on all sprayed trees, but later became severe on those sprayed with DDT ; it showed an initial increase on the unsprayed trees, but had practically disappeared by December. The Hymenopterous parasites, *Prospaltella aurantii*, How., and *Pseudhomalopoda prima*, Gir., were also more or less unaffected by the oil sprays ; they were virtually eliminated by the DDT, but appeared to have reached normal numbers again by December.

The leaves of the trees were found to bear a deposit of approximately 5 mmg. p,p′ DDT per sq. cm. on 24th July and analyses in late November and December showed that there was again about 5 mmg. per sq. cm. on the leaves of all the experimental trees, whether they had received DDT during the summer or not. Each of the DDT sprays applied an additional deposit of 10 mmg., but it is thought, from the results of unpublished studies of DDT on *Citrus* foliage in Florida, that these deposits were reduced to 5 mmg. within four weeks, and it is probable that the damage to parasites and predators was accomplished during this period. There therefore appears to be an irreducible minimum amount of DDT that remains in or on the leaves for a very prolonged period and appears to have no effect on *Chrysomphalus* or its natural enemies.

MASON (P. W.). **A new Pear Aphid (Homoptera, Aphidae).**—*Proc. ent. Soc. Wash.* **49** no. 9 pp. 252–254, 17 figs. Washington, D.C., 1947.

Descriptions are given of the alate males, alate and apterous viviparae, stem mothers and apterous oviparae of *Macrosiphum gentneri*, sp. n., which was taken on pear in Oregon. It was not found on any other plant.

BORG (Å.). **Bekämpningsförsök mot plommonstekeln.** [Experiments on the Control of *Hoplocampa minuta*.]—*Växtskyddsnotiser* 1948 no. 4 pp. 54–56. Stockholm, 1948.

The results are given of three tests in Sweden in 1947 and 1948 in which proprietary insecticides were compared in sprays against *Hoplocampa minuta*, Christ, on plum. They comprised a DDT emulsion concentrate, another emulsion concentrate of DDT and BHC (benzene hexachloride) with other unstated insecticides, and a preparation of pyrethrum and BHC. All gave good results, and one application shortly before or after flowering was nearly as good as one before and one after.

OSSIANNILSSON (F.). **Ett för vårt land nytt skadedjur på gräs.** [A new Pest of Grass in Sweden.]—*Växtskyddsnotiser* 1948 no. 5 pp. 79–80. Stockholm, 1948.

Following a dry summer in 1947, *Toxoptera* (*Rhopalosiphum*) *graminum*, Rond., which was known to occur in Sweden but had never proved harmful there, became extremely numerous on meadow grasses, especially timothy [*Phleum pratense*], in several districts in 1948. It was sometimes accompanied by the Jassid, *Macrosteles laevis*, Ribaut, which had also been favoured by the weather, and in such cases it was not possible to decide which was chiefly responsible for the bare patches that appeared.

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LIBRARY LACUNAE.

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Agricultural Chemicals (New York, N.Y.) : Vol. 1 (1946) Nos. 1–2, 4–5.
Agricultural Journal, Department of Agriculture, British Columbia (Victoria) : Vol. 1 (1916), Nos. 1 and 2.
Agricultural News (Barbados) : Nos. 1, 25, 26, 34, 66 (1902–04).
Agriculture and Animal Husbandry in India (Delhi): 1937–38.
American Journal of Veterinary Research (Chicago, Ill.) : Vols. 1 & 2 (1940–41) Nos. 1–5.
Analele Institutului de cercetări Agronomice al României (Bucharest) : Tome 14 (1942).
Annals of the Queensland Museum (Brisbane) : No. 5.
Arbeiten der Biologischen Station zu Kossino (Moscow) : Lief. 1 (?1925).
Archives de l'Institut d'Hessarek (Hessarek–Karadj) : Fasc. 1 (1939), 2 (1940).
Archives de l'Institut Pasteur de Tunis : 1906 fasc. 4 ; 1907 fasc. 1 & 3 ; 1908 ; 1909 fasc. 1–2, 4 ; 1910 fasc. 1–3 ; 1911 fasc. 3–4.
Archives du Musée Zoologique de l'Université de Moscou : Vol. 5 (?1938).
Arizona Commission of Agriculture and Horticulture (Phoenix, Ariz.) : 1st–10th Annual Reports ; Circulars 15–16 (1909–18).
Arquivos do Instituto Bacteriologico Câmara Pestana (Lisbon) : Vol. 1 (1906).
Bee World (Benson, Oxon) : Vols. 1–2 (1919–21).
Bericht über die Wissenschaftlichen Leistungen im Gebiete der Entomologie während des Jahres 1914 (Berlin) : Nos. 1 & 5.
Biological Bulletin of the Marine Biological Laboratory (Woods Hole, Mass.) : Vols. 1–2 (1899–1901) ; 23 (1912) ; 24 (1912) No. 2 ; 25 (1913) Nos. 5–6 ; 26 (1914) Nos. 1–2 ; 27 (1914) No. 4 ; 28 (1915) No. 1 ; 29 (1915) No. 5 ; 30 (1916) Nos. 2–3 ; 31 (1916) Nos. 4 & 6 ; 32–33 (1917) ; 34 (1918) Nos. 1–4 ; 35 (1918) ; 36 (1919) Nos. 2–3 ; 37 (1919) Nos. 4 & 6 ; 38 (1920) Nos. 1, 2, 5 & 6 ; 39 (1920) Nos. 4–6 ; 40 (1921) Nos. 1–3 & 6 ; 41 (1921) Nos. 2 & 3 ; 42 (1922) Nos. 1–3.
Boletín de la Dirección de Estudios Biológicos (Mexico) : Tomos 1–2 (1924–25).
Bollettino della Società Italiana di Biologia Sperimentale (Naples) : Vols. 17 (1942) Nos. 5–6 ; 18–21 (1943–45).
Bulletin Agricole de l'Algérie-Tunisie-Maroc (Algiers) : Année 20 (1914) Nos. 7–9, 12–14.
Bulletin du Comité d'Études Historiques et Scientifiques de l'Afrique Occidentale Française (Paris) : Année 1919 No. 1.
Bulletin de l'Institut des Recherches Biologiques (Perm) : Tome 1 (1923) fasc. 1–2.
Bulletin de la Station Régionale Protectrice des Plantes à Leningrad : Vol. 6 (?1927) ; 7 (1936) No. 2.
Bulletin of the Stoneham Museum (Kitale) : Nos. 37, 41.
Caribbean Forester (New Orleans, La.) : Vol. 1 (1940) No. 1.
Chacaras e Quintaes (São Paulo) : Indices to Vols. 10, 11, 12, 14 ; Vol. 42 (1930) No. 3.
Chinese Medical Journal (Chengtu) : Vol. 61A (1942) No. 1.
Choroby Roślin (Warsaw) : T.1 cz.1 (1931).
Comptes Rendus des Séances de l'Académie d'Agriculture de France (Paris) : Tome 8 (1922) No. 5.
Comptes Rendus de l'Académie des Sciences de l'URSS (Moscow) : (N.S.) Vols. 26 (1940) Nos. 8–9 ; 27 (1940) ; 28 (1940) No. 1 ; 33 (1941) Nos. 4–6 ; 41 (1943) Nos. 8–9 ; 44 (1944) Nos. 4–9 ; 45 (1944) No. 1 ; 48 (1945) Nos. 4–5 ; 54 (1946) No. 9 ; 55 (1947) No. 7 ; 56 (1947) No. 2.
Cyprus Agricultural Journal (Nicosia) : Vol. 23 (1928) Pt. 3.
Dokladui Akademiĭ Nauk SSSR (Moscow) : (N.S.) Vols. 57–58 (1947) ; 59 (1948) Nos. 8–9 ; 60 (1948) Nos. 1–3.
Egatea, Revista da Escola de Engenharia de Porto Alegre, Brazil (Porto Alegre) : Vols. 1–6 (1916–21) ; 7 (1922) Nos. 1–5 ; 8 (1923) Nos. 2–5 ; 9 (1924) Nos. 1, 4–6.
Egypt. Ministry of Agriculture (Cairo) : Bulletins 158, 162, 170–172, 174, 204, 212, 215, 227, 228, 230, 232, 235 ; Report of the Entomological Section for 1923–24.
Entomologische Litteraturblätter (Berlin) : 6 Jahrg. (1906) Nos. 2 & 10.
Experiment Station Record (Washington, D.C.) : Vols. 1–4 (1889–94).
Fitófilo (San Jacinto, D. F.) : Año 1 (1942) No. 6.

LIBRARY LACUNAE—*cont.*

Florida Agricultural Experiment Station (Lake City & Gainesville, Fla.): Reports for 1896, 1898–99, 1899–1900, 1900–1901, 1908–09.

Folia Myrmecologica et Termitologica (Bernau b. Berlin): Vol. 1 (1927) No. 10 to end.

Forest Products Research Board (London): Report for the period ended 30th September, 1928.

Forêt Québecoise (Quebec): Vols. 1 (1939) Nos. 1, 4, 6, 10; 2 (1940) Nos. 1, 3, 6.

Gambia: Medical and Sanitary Reports 1939–42.

Georgia State Board of Entomology (Atlanta, Ga.): Bulletins 2, 6, 22 and 28; Circulars 1–3, 12, 15–18 and 20.

Gold Coast Department of Agriculture: Bulletin 25 (1932).

Harvard Forest Bulletin (Petersham, Mass.): No. 5 (1922).

Hong Kong. Botanical and Forestry Department: Reports for 1928 & 1939.

India. Forest Research Institute (Dehra Dun): Forest Bulletin (Old Series) Nos. 1–3.

India. Imperial Council of Agricultural Research (Delhi): Annual Report for 1939–40.

Indian Central Jute Committee. Agricultural Research Laboratory (Calcutta): Annual Report 1941–42.

Indian Lac Research Institute (Namkum): Report for 1942–43.

Indian Medical Gazette (Calcutta): Vols. 50 (1915) No. 10; 51 (1916) Nos. 1–7, 10; 52 (1917) No. 7 and title-page & index; 53 (1918); 54 (1919) No. 2; 76 (1941) title-page & index; 77 (1942) No. 8; 78 (1943) Nos. 1 & 10; 81 (1946) title-page & index.

Insekto Interesa (Nantung): Vols. 1 (1935) Nos. 1, 4 to end; 2 (1936) No. 5 to end.

Izvestiya Uzbekistanskogo Filiala Akademiĭ Nauk SSSR (Tashkent): 1940 No. 9.

Jamaica. Department of Agriculture (Kingston): Bulletin 31 (1941); Annual Report 1903–04, 1907–08, 1909–10, 1911–12.

Journal of Agricultural Research (Washington, D.C.): Vols. 59 (1939) Nos. 4, 5, 11, 12; 61 (1941) No. 3.

Journal of the Board of Agriculture of British Guiana (Demerara): Vol. 3 (1909) No. 1; title-pages & indices to vols. 1–2.

Journal of the South-Eastern Agricultural College (Wye, Kent): Nos. 1–6, 8 (1895–99).

Kenya and East African Medical Journal (Nairobi): Vol. 2 (1925) Nos. 2–3.

Konowia (Vienna): Bd. 17 (1939) Heft 2–3.

Medical Parasitology and Parasitic Diseases (Moscow): Vols. 1 (1932) No. 1; 11 (1943) Nos. 1–3; 12–13 (1943–44); 14 (1945) Nos. 5–6; 15 (1946) Nos. 1–3.

Mezögazdasági Kutatások (Budapest): Vols. 2 (1929) No. 7–8; 13 (1940) Nos. 7, 11–12; 14 (1941) Nos. 4, 8–12 & index.

Mitteilungen der Gesellschaft für Vorratsschutz (Berlin): Jahrg. 16 (1940) Hefte 1 & 5; 17 (1941).

Natuurhistorisch Maandblad (Maastricht): Jaarg. 1 (1912); 2 (1913) Nos. 1–4, 6–9; 5 (1916) Nos. 3–4; 7 (1918) Nos. 6–9; 8 (1919) No. 4.

Nauchnuie Zapiski po Sakharnoĭ Promuishlennosti. Agronomicheskiĭ Vuipusk (Kiev): God 14 (1937) vuip. 4–6; 15 (1938) vuip 5–6.

New Jersey State Department of Agriculture (Trenton, N. J.): Circulars 2, 12, 29 (1917–19).

New York State Museum (Albany, N.Y.): Bulletin 57 (1902).

North Carolina Agricultural Experiment Station (Raleigh): 38th (1914–15), 49th (1925–26), 51st (1927–28), 52nd (1928–29) Reports.

Northern Rhodesia. Veterinary Department: Report for 1940.

Ontario Entomological Society (Toronto): 9th Report (1878).

Ormerod (E. A.). Observations of Injurious Insects and Common Farm Pests during the Years 1877 & 1878 (London, 1878–79).

Pensée Médicale d'Usbéquistane et de Turquménistane (Tashkent): Vol. 5 (ix-x) (1931) Nos. 1–3, 5 to end.

Peru. Ministerio de Agricultura. Estación Experimental Agrícola de La Molina (Lima): Informe 56 (1943); Boletín 24 (1943); Circular 61 (1943).

Pests and Their Control (Kansas City, Mo.): Vol. 15 (1947) Nos. 7–8.

Philippine Agriculturist (Laguna): Vol. 30 (1941) No. 9.

Philippine Journal of Agriculture (Manila): Vols. 9 (1938) No. 3; 10 (1939) No. 3; 11 (1940) Nos. 1–3 & index; 12 (1941) No. 3 & index.

Philippine Journal of Science (Manila): Vols. 72 (1940) No. 4; 76 (? 1941) No. 2.

Porto Rico Department of Agriculture, &c. (San Juan): Journal, Vol. 1 (1917) No. 3.

Proceedings. California Mosquito Control Association (Berkeley): 14th annual conference 1945.

Proceedings. Ohio State Horticultural Society (Columbus, Ohio): Vol. 79 (1946).

Psyche (Boston, Mass.): Vols. 11 (1904), 13 (1906), 16 (1909).

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